SOUTH AFRICAN SUGAR ASSOCIATION

EXPERIMENT STATION

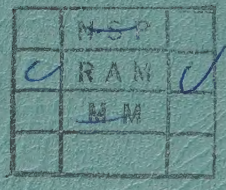
MOUNT EDGECOMBE

NATAL

REPORT

for

1961 – 1962



The Experiment Station Laboratories — New Look 1962.

The Experiment Station

The Experiment Station of the South African Sugar Association is financed wholly from funds contributed by the Sugar Industry, the South African Cane Growers' Association and the Natal Sugar Millers' Association sharing the cost of maintenance and development.

The main station at Mount Edgecombe, first established in 1925 and consisting of 116 acres held on long lease from The Natal Estates Ltd., now serves as the headquarters of the administrative, research, advisory, and extension services and is also the main centre for sugarcane breeding. Field facilities have been extended from time to time to meet the increasing demands of an expanding experimental programme.

Thus in 1946, 200 acres were acquired on long lease near Chaka's Kraal, some 25 miles further north of Mount Edgecombe. They have been developed with irrigation facilities for a wide range of field trials.

A further 300 acres were purchased outright in 1955 near Mtunzini in Zululand and this area is now being developed as an additional field trial and seed propagation station.

The Experiment Station also incorporates a Fertilizer Advisory Laboratory which provides a free advisory service to all sections of the Industry.

An extensive reference library covering all aspects of sugar production and the sciences relevant thereto is maintained at the Experiment Station. The library, and the various services it provides, is open to all members of the Industry and to approved institutions and organisations outside of the Industry proper.

Functions of the Experiment Station

The principal functions of the Station are as follows :

1. The development of new varieties of sugarcane both by breeding and by introduction and the propagation and distribution of selected varieties to meet the diverse needs of the Industry.

2. The investigation of agronomic problems of sugarcane production.

3. The studies of the soils of the sugarcane producing areas.

4. The study of the nutritional requirements of sugarcane.

5. The study of pests and diseases of sugarcane and the development of appropriate control measures.

6. Other investigations on such problems as arise from time to time.

7. The dissemination of information relating to sugarcane production.

8. The issuing of advice on fertilizer usage, disease and pest control and other aspects of crop management.

9. The exchange of information and material, and collaboration with other research institutions in South Africa and other countries.

COMMITTEE OF THE EXPERIMENT STATION
1961 - 1962

O. W. M. PEARCE *(Chairman)*
W. J. G. BARNES *(Vice-Chairman)*
W. K. BUCHANAN
G. C. FLEWELLEN
H. L. GARLAND
F. S. V. GILLATT
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O. W. M. PEARCE *(Chairman)*
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Co-opted from Experiment Station Staff:

J. WILSON *(Director)*
L. B. WEBER *(Secretary)*

THE EXPERIMENT STATION

MOUNT EDGECOMBE

with

THE EXPERIMENTAL FARM, CHAKA'S KRAAL, NORTH COAST, NATAL.

THE PROPAGATION FARM, MTUNZINI, ZULULAND, NATAL.

List of Staff.

APRIL, 1962.

Director :
J. WILSON, B.Sc. Hons. (Dunelm)

Chief Research Officer :
J. L. DU TOIT, M.Sc. (Stellen.)

Secretary :
L. B. WEBER, F.C.C.S.

Professional Staff.

Chief Agricultural Officer : C. H. O. PEARSON, B.A. (Oxon), B.A. (Cantab.).

Research Agronomist : G. D. THOMPSON, B.Sc. (La.).

Regional Agronomists :
C. E. BOOTH.
A. M. MacDONALD, B.Sc. (Aberdeen), D.T.A. (Trin.).

Chief Research Chemist : J. L. DU TOIT, M.Sc. (Stellen.).

Chemist : G. H. WOOD, B.Sc., Hons. (Natal).

Chemist : K. E. F. ALEXANDER.

Chemist : R. T. BISHOP, B.Sc. Agric. (Natal).

Microbiologist : J. R. ANDERSON, B.Sc. Agric. (Natal).

Soil Scientist : B. E. BEATER, B.A., D.Sc. (Afric), F.R.I.C., F.R.S. (S.A.).

Pedologist : R. R. MAUD, B.Sc., Hons. (Natal).

Plant Breeder : P. G. C. BRETT, M.Sc. (S.A.), Ph.D. (Natal).

Assistant Plant Breeder : T. B. BRASSEY, B.A. (Oxon.).

Plant Pathologist : G. M. THOMSON, M.Sc. (Natal).

Entomologist : J. DICK, M.Sc. (S.A.), Ph.D. (London), D.I.C.

Biometrician : H. M. DICKS, B.Sc. Agric. (Natal).

Regional Representatives (Extension) :
J. M. ROBERTSON, B.Sc. Agric. (Edin.).
D. P. UPTON.
D. A. ROUTLEDGE, B.Sc. Agric. (Natal).

Technical Staff.

Farm Managers :
F. L. ALMOND (Experiment Station).
K. W. L'ANGE (Experimental Farm).
L. H. GORVETT, Dip. Afric. (Cedara) (Propagation Farm).

Agricultural Assistants :
R. KRUUSE. Dip. Agric. (Cedara).
N. A. KLETTE, Dip. Agric. (Cedara).
J. TE RIELE, Dip. Agric. (Cedara).

Disease Inspectors :
H. V. FRANCES.
R. H. HALSE.

Laboratory Assistants:
MRS. M. WELLS.
MISS H. BLEVINS.

Clerical Staff.

MRS. N. V. SARGENT.
MRS. H. A. LAMB.
MRS. L. BAPTIE.
MISS G. E. SMITH.
MRS. N. VAN DER MERWE.

Maintenance Services.

Building Supervisor : H. G. MUNRO.

Transport Foreman : A. E. LANG.

General Report

INTRODUCTION.

THE sharp drop in the consumption of fertilizers noted in the report for 1960-61 continued during the current year to the extent that less than half the fertilizer used in 1959 was consumed in 1961. Coinciding as it has with a rainfall well below average during the period December 1961-May 1962, this drastic reduction in the use of fertilizer must inevitably have serious repercussions in the crop due to be harvested in 1962-63. While there is little doubt that any shortfall in production which does arise will be attributed by most growers solely to the drought, there is ample evidence from experiments to show that the depressing effects of drought are considerably exaggerated in a crop already debilitated by inadequate fertilization, a state of affairs which must be applicable to quite a substantial proportion of the current crop.

During the months of June, July and August, 1961, sugarcane flowered to a degree and in areas seldom seen in the cane belt, and at the Experiment Station varieties such as P.O.J.2714 which had never ever been recorded as flowering in Natal, produced tassels quite freely. Although a combination of factors favouring flowering was probably responsible for this, two of the most important contributory factors were the high temperatures prevailing during March and April 1961 at the time of floral initiation and the good late rains which coincided with these high temperatures. While this flowering is unlikely to have any significant effect upon the crop cut before the end of the 1961-62 cutting season, any cane carried over into 1962-63 seems destined to have a high fibre per cent cane on account of dead sticks and side shooting.

The 1961-62 harvesting season also witnessed the most devastating and extensive runaway cane fires in the history of the industry. These fires raised many problems for both grower and miller, not the least of which was how best to organise the cutting of burnt cane so as to keep losses due to deterioration to a minimum. Preliminary tests with burnt, and unburnt trashed cane indicated that it is better to leave burnt cane standing until it can be transported rather than to cut immediately and stockpile in the field. However losses of the order of 10% of the sucrose originally present after a period of about one week, regardless of whether the cane is cut immediately after burning or left standing, clearly indicates that the primary objective after a runaway fire must be to get the cane to the mill with all possible speed.

RESEARCH.

Wherever research shows that there is a clearcut and reproducible response to a particular treatment or operation the need for further experimentation largely falls away other than to confirm that the treatment or operation is economically justifiable and has no deleterious side or after effects, and the treatment can be recommended without reservation as normal practice.

It is much more frequently the case however that the responses evoked by a particular treatment or operation are variable to a degree that may make it unwise to draw more than tentative conclusions concerning the efficacy of the treatment. It is unlikely in such instances that repetition of the experiment in its original form will serve any purpose other than to confuse the issues still further.

It is in fact fast becoming obvious in certain fields of investigation, particularly in those concerning crop nutrition, crop/soil and crop/water relationships, the differential behaviour of varieties, etc., that a more complete understanding of the fundamental processes of crop growth in relation to the varied environments under which cane is grown in Natal, is essential if any real progress is to be made toward a rational improvement in crop production.

The work in progress on soil chemistry, soil moisture, and soil temperatures, outlined in the soils section of this report comes into the category of research noted above. Against a background of such information as is emerging from this work, the varying responses in crop growth to fertilization, trash management, irrigation, etc., in different parts of the cane belt become somewhat more comprehensible. It also serves to emphasise the need for well planned experiments incorporating complete records of climatic and environmental data as well as of the crop itself.

The positive identification of zinc deficiencies in cane in certain areas of the cane belt during the past season has sounded a warning that there is more to crop fertilization than straight N, P and K and that more intensive production is likely to raise problems such as this at a greater rate than has been apparent heretofore.

Preliminary investigations into the distribution of starch within the cane plant and the factors influencing the starch content of cane have yielded some interesting results to date. Thus the potential starch content appears to be inherent in

the variety, some being much higher in starch than others. In all canes examined so far proportionately much more starch is found in the nodes than in the internodes. The starch also appears to be largely concentrated in the top 2-3 feet of the stick, the top 6 inches having a very high starch to sucrose ratio. Starch content was lower in irrigated cane and in cane where yield responses were obtained to applications of nitrogen and more particularly of potash. The indications are therefore that well-grown, well topped cane will be reasonably low in starch content even though the variety may have a relatively high inherent potential starch content.

Although the crossing procedure developed by the Plant Breeder has revolutionised the cane breeding position in Natal, there are many difficulties attached to it. Not the least of these difficulties is the problem of how to ensure that those shoots intended as male parents and subjected to high night temperatures actually reach maturity. A considerable number of mortalities normally occur during this part of the procedure and much time and effort is spent fruitlessly in handling material destined to die or be useless in the end for breeding purposes. It has been shown possible this season that by a simple modification of procedure the survival rate of treated male inflorescences may be increased by a substantial though still not entirely satisfactory degree.

Field trials and farm surveys continue to indicate the importance of mosaic, smut, and ratoon stunting disease in the cane belt. The testing for resistance to these and other diseases constitutes an integral part of the selection procedure in variety work. This is far from being a straightforward matter however, not only from the genetic difficulty of combining multiple disease resistance into an agronomically acceptable variety and being able to select out that variety, but also from the fact that in the case of smut, for example, it has proved impossible so far to find a really satisfactory method for testing for resistance. Further in the case of ratoon stunting disease we have yet to identify positively the natural mode of transmission or vector of the disease or even find a truly positive means of diagnosis.

Improvements in the techniques of breeding and testing for resistance to disease are constantly being sought but a satisfactory solution to the many problems involved still seems a long way off. Meanwhile it is incumbent upon the farmer to play his part in order to maintain the varieties which have been released in as healthy a condition as possible and to take full advantage of the services offered by the Experiment Station to achieve this end.

Of particular interest at a time when costs of production assume even greater significance than usual, is the finding that many operations normally practiced at the time of crop re-establishment are apparenly either completely unnecessary or are carried to unnecessary extremes, thus involving excessive expenditure of horse power, labour, and time without any attendant benefits. If to the saving here are added those which can be effected by correctly timing all essential operations, it seems that overall, the standard costs of re-establishment could probably be halved.

It is probably fair to assume that there are other accepted practices in crop production which come into the same category.

Before setting out to devise the most economical means of executing a particular operation therefore, it seems very necessary in the first place to ensure that the operation itself is essential !

The remarkable yields obtained in the lysimeter experiments are of more than passing significance to an Industry committed to controlling the production of sugar. It is, of course, one thing to control — or perhaps a more apt word would be restrict — the amount of sugar manufactured each year to match the amounts required to fill available outlets, and quite another matter to adjust cane production so as to produce those amounts of sugar with the minimum wastage of crop. In point of fact except in areas where irrigation facilities exist and on the alluvial flats of Zululand, the nearest the average farmer can get to controlling his production of cane is to have planted up a sufficiently large acreage which will ensure him even in a dry year a small surplus over the amount that he estimates will be required to meet his delivery quota.

It is tempting to attribute the difficulties which arise from such a situation to the restrictions which have been imposed on output and to assume, once these restrictions are lifted, that all will be well. The fact remains however that until the environment, and more particularly the water component of that environment, is brought under control, the individual farmer will never be able to plan or control his cane production with any degree of exactitude at any time, regardless of whether restrictions are in force or not. The issue however goes considerably further than merely the control of production of sugarcane, for fundamentally it is a matter of how best to exploit both the environment and the land within the limits set by the application of sound conservation practices so as to achieve maximum profitability per unit area in unit time.

It is a matter for some concern therefore in a region abounding with potential dam sites, blessed with a rainfall which, even though often erratic

in distribution, is usually adequate in quantity, and enjoying a climate which favours crop growth for practically the whole year, that farmers in the cane belt should remain so indifferent to water conservation for the development of irrigation schemes. When yields of the order of four times the industrial average for sugarcane alone can be achieved with irrigation it becomes not so much a case of not being able to afford the cost of development and installation of irrigation but rather for how long a farmer can afford to be without it. With irrigation resources fully developed the output of agricultural products from the acreage at present under sugarcane in Natal could be increased enormously, for many crops other than sugarcane await profitable development on the land which could be released from cane if it were grown intensively on a smaller acreage.

Experience this year with cotton has confirmed that with proper attention to cultural practices and crop protection, highly remunerative yields can be obtained in the cane belt. The production of kenaf which has been undertaken on a substantial scale by one of the miller-cum-planter companies has also shown considerable promise. The productivity of planted pasture grasses and legumes such as lucerne with appropriate fertilization and management under coastal conditions has been such as to reinforce the view that insofar as feeding is concerned the cane belt is probably better than most areas in the country for the production of livestock and that the development of large scale cattle and dairying industries in the cane belt is not beyond the bounds of possibility.

ADVISORY AND EXTENSION SERVICES.

The year under review was notable more perhaps for the intense interest shown in crops and agricultural pursuits other than cane culture.

Most growers, faced with large surpluses of cane left standing over from the previous season were at least in the early part of the year, more concerned with problems of disposal than of production. Advisory and extension staff assisted farmers wherever possible in their difficult task of deciding where priorities lay but the widely differing circumstances encountered from farmer to farmer rendered it impossible to formulate a policy having any semblance of general applicability.

In view of the widespread interest shown in cotton and coffee in particular, information on these two crops was collected from various sources and issued in bulletin form to all growers so that those intending to take the matter further had the basic information for production of the crop at their disposal. Extension staff were able to assist in the development stages of these crops during the course of their normal programme of farm calls.

The Fertilizer Advisory Laboratory at Redhill, Durban, was closed down at the end of 1961 in order to effect the transfer of essential equipment, instruments and laboratory fittings to the Chemical Services Laboratory incorporated in the new Laboratory wing at the Experiment Station. Essential analyses were carried out meanwhile in the old Chemistry Laboratory at the Station. Owing to the greatly reduced planting programme within the industry and the general recession in the use of fertilizers the transfer was made with very little disruption to the normal services to the farmer.

NEW LABORATORIES AND OFFICES.

The new laboratory wing at the Experiment Station was completed, with the exception of some minor installations, by the end of March 1962 and became operative during April. This has brought all research, advisory and administrative services under one roof and the improved accessibility arising therefrom has already had beneficial effects in the day to day running of the Station.

ADMINISTRATION AND SERVICES.

Following on the opening of the new Laboratories and the centralisation of services at the Experiment Station, the opportunity was taken to improve the methods of procurement and control of laboratory and general stores by the setting up of a Central Buying Office and a Central Stores. This has not only led to substantial economies as a result of bulk purchasing but has also led to more efficient use being made of existing stocks of laboratory apparatus and equipment. At the same time the research and advisory sections have been relieved of the routine administrative duties associated with laboratory stores and thus enabled to devote more time to productive work.

Apart from completing the new laboratory, the Building Section also undertook alterations to the transport workshop at the Mtunzini Propagation Farm. This has now been laid out as a model farm workshop in accordance with specifications drawn up by the Field Mechanisation Engineer. The old Bachelors' Quarters at the Experiment Station were converted into one single-bedroomed, and two two-bedroomed flats.

DELEGATIONS, VISITS, ETC.

Mr. C. H. O. Pearson, Chief Agricultural Officer, and Mr. G. D. Thompson, Research Agronomist (designate), attended the Africa and

Irrigation Symposium held in Salisbury, Southern Rhodesia, from 21st-29th September, 1961.

Mr. Thompson visited other research stations in Southern Rhodesia and Nyasaland after the Symposium.

REPRESENTATION.

The Experiment Station was represented on the following Committees by the members of staff noted :—

(a) Industrial Field Mechanisation and Labour Saving Committee—the Director.

(b) Advisory Research Committee of the Sugar Milling Research Institute—the Director and the Chief Research Officer.

(c) Advisory Committee for the Pongola Settlement — the Chief Research Officer.

Mr. J. L. du Toit, Chief Research Officer was re-elected President of the South African Sugar Technologists' Association for the year 1962.

Dr. J. Dick and Mr. J. Wilson served on the Council of the above Association for the year 1961-62.

TECHNOLOGISTS' CONGRESS.

The Annual Congress of the South African Sugarcane Technologists' Association was held at the Experiment Station for the first time in 1962 when the new Conference Room became the venue for the 36th Annual Congress from 9th-13th April.

With its ready accessibility from all parts of the cane belt, ample parking facilities, ample and comfortable seating accommodation and the excellent services for meals and refreshments provided by the local Sports Club and Women's Institute the venue met with the full approval of all technologists.

TECHNICAL CO-OPERATION.

Following on the successful unofficial conference of soil scientists held last year reported in the Annual Report for 1960-61 a further profitable meeting was held in Natal during the current year.

Mr. J. B. D. Robinson, Director of the Coffee Research Station, Lyamungu, Tanganyika, with the permission of his Government, visited Natal at the invitation of the Experiment Station Committee from 6th-16th August 1961 in order to advise the Experiment Station on the possibilities of growing coffee in the cane belt.

Mr. A. H. McKinstry, Officer-in-Charge of the Gatooma Research Station, Southern Rhodesia, with the permission of his Government also visited Natal at the invitation of the Experiment Station Committee for a short visit from 21st-26th May 1962 to advise the Experiment Station on cotton growing in the cane belt.

The Experiment Station co-operated with the Department of Agriculture, Natal Region, by providing facilities and assisting with the supervision and recording of a small programme of investigations on the production of lucerne, pasture grasses, cotton and soya beans under coastal conditions.

ACKNOWLEDGEMENTS.

The Experiment Station Staff acknowledges with grateful appreciation the co-operation received from official research institutions and private organisations both from within and beyond the borders of South Africa.

Thanks go also to the many members of the South African Sugar Industry who by their active co-operation and assistance have enabled the planned programme of co-operative field experiments to be concluded satisfactorily in spite of even more difficult circumstances than were experienced in the previous year.

Soils

Soil Scientist : B. E. BEATER

THE SOIL GROUPS.

THE soil survey of the sugar belt which was commenced late in 1954 was completed in June 1961. There were altogether 1,132 estate map sheets made available, drawn to a scale of 1/6000, and the field-by-field soil survey utilised all these maps.

The total area represented by these map sheets was 748,117 acres, which is not the total area of the industry. It is estimated that there are a further 144,000 acres under cane which have not been mapped for soils. This area is accounted for as follows :

39,000 acres increased acreage under cane 1959/61
34,000 acres European areas, no maps provided
55,000 acres Indian areas, no maps provided
16,000 acres Bantu areas, no maps provided.

As a result of this, the soil survey represents approximately 77.1 per cent of the total area of the sugar industry.

With the completion of field mapping in June 1961, the large amount of accumulated material was sorted out, soil group boundaries clearly defined on linen maps and areas of all soil groups computed for each estate. As a result, a record is now available for each grower, should he require it, of the distribution and areas of the various soil groups on his estate.

The value of soil group maps to the industry are :

1. Assistance in fertilizer advisory work.
2. Guidance in location of variety and fertilizer trials.
3. Assessment of relative importance of soil groups in the regional pattern.
4. Assisting the grower to :
   (a) Manage and recognise soils on the basis of their physical characteristics, drainage, etc.
   (b) Plan intensification on better soils.
   (c) Control irrigation by known water requirements.
5. Discussions with visiting scientists.

The preparation of the report on the soils of Zululand occupied some time. This report which will comprise Report Number 5 of the Natal Regional Survey series, presents data relative to rainfall and temperatures in Zululand and acreages of soil groups, total estate and actually under cane, representing the various sugar factories. In a more general sense the report also presents :

1. Percentages of soil groups on North Coast, South Coast and in Zululand.
2. The extent of cultivation of sugar belt soil groups on North Coast, South Coast and in Zululand.
3. The place of the sugar belt soil groups in the all-Africa soil survey.
4. Numerous tables depicting the distribution and percentages of the soil groups for the whole of the industry, factory by factory, the relative proportions of miller-growers and growers being also presented in each case.

As regards the soils of Zululand, the study of which has occupied most of the period under review, there are a number of points of interest. The following table presents the acreages of the total estate and actually under cane :

	Total acreage of estates	Acreage actually under cane
	acres	acres
Soils derived from pre-granite quartzite	545.3	345.0
,, ,, ,, Tugela schist	14,161.7	11,353.6
,, ,, ,, granite	16,681.7	10,685.6
,, ,, ,, T.M.S. (Ordinary)	25,031.9	12,842.9
,, ,, ,, T.M.S. (Mist belt)	8,965.5	7,183.7
,, ,, ,, T.M.S. (Boulder beds)	444.3	334.0
,, ,, ,, Dwyka tillite	8,137.4	5,813.3
,, ,, ,, Lower Ecca shale	13,595.5	9,519.2
,, ,, ,, Middle Ecca sediments	38,737.3	26,749.2
,, ,, ,, Beaufort sediments	13,459.3	4,899.1
,, ,, ,, Stormberg sediments	602.5	80.6
,, ,, ,, dolerite and basalt	32,282.7	22,036.7
,, ,, ,, Cretaceous sediments	1,848.3	1,077.7
,, ,, ,, Tertiary sandstones	6.1	6.0
,, ,, ,, Recent Sands (Red)	25,018.6	15,882.9
,, ,, ,, Recent Sands (Grey)	35,752.1	15,101.6
,, ,, ,, Alluvium	56,055.7	41,243.0
	291,325.9	185,154.1

Soils

The percentage area of soil groups actually under cane (i.e. cultivated) for Zululand and for the entire industry are presented below in order to illustrate to what extent the sugar belt is reliant upon the various kinds of soil :

	% soils actually under cane in Zululand	% soils actually under cane in entire industry
	per cent	per cent
Soil derived from pre-granite quartzite	0.2	0.2
,, ,, ,, Tugela schist	6.1	3.7
,, ,, ,, granite	5.8	11.2
,, ,, ,, T.M.S. (Ordinary)	6.9	17.0
,, ,, ,, T.M.S. (Mist belt)	3.9	4.9
,, ,, ,, T.M.S. (Boulder beds)	0.2	0.2
,, ,, ,, Dwyka tillite	3.1	9.9
,, ,, ,, Lower Ecca shale	5.1	7.8
,, ,, ,, Middle Ecca sediments	14.4	9.7
,, ,, ,, Beaufort sediments	2.7	1.0
,, ,, ,, dolerite and basalt	11.9	9.2
,, ,, ,, Cretaceous sediments	0.6	0.2
,, ,, ,, Recent Sands (red)	8.6	8.0
,, ,, ,, Recent Sands (grey)	8.2	5.3
,, ,, ,, Alluvium	22.3	11.2

A feature of interest in the Zululand soil survey is the location of extensive areas of soils derived from Beaufort sediments. Experience has shown that these soils are liable to develop salinity unless correctly drained. Boreholes within the formation invariably yield very saline water. Another soil of interest is that derived from Cretaceous sediments. The above table shows that only 0.2 per cent of these soils are found within the industry, but as such soils occur very extensively in the new areas scheduled for irrigation in the future, it is extremly likely that more will be heard of these soils. They are very fertile, but owing to the nature of the parent material (calcareous rock) can lead to complications if not managed correctly under irrigation.

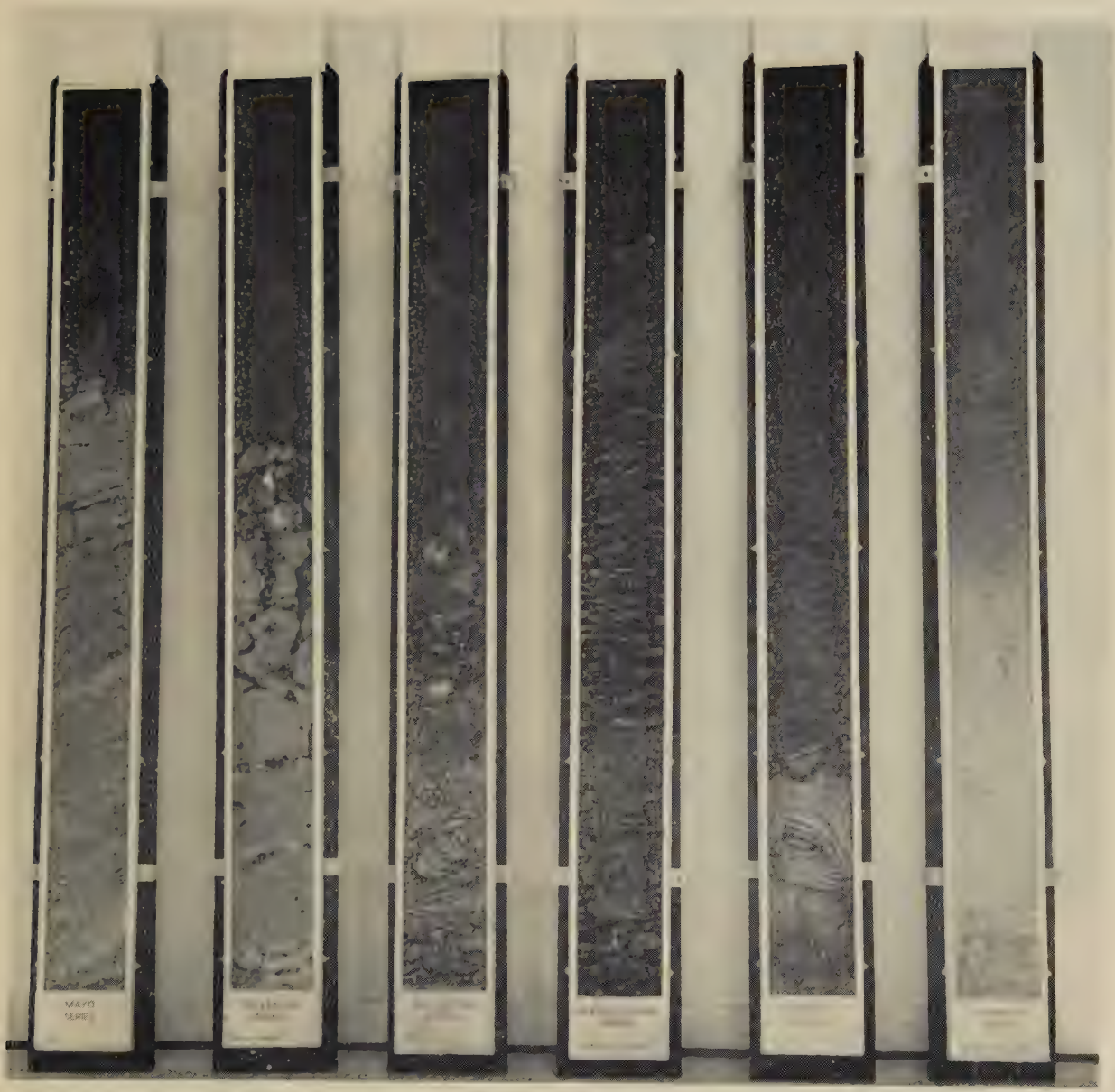
It is interesting to note that soil derived from Table Mountain sandstone (Ordinary) is by far the major soil group within the industry. This soil group is well known for its need for fertilizer, in particular nitrogen. In conjunction with granite, another light textured soil, it becomes evident that most of the soils of the industry are of a sandy loam texture. An assessment from general knowledge of the soils gives the following percentage of textural classes for the cultivated soils of the industry :

Sands and sandy loams	(0 — 15% clay)	48 per cent
Loams	(15 — 30% clay)	19 ,, ,,
Clayey loams	(30 — 45% clay)	25 ,, ,,
Clayey soils	(more than 45% clay)	8 ,, ,,

THE SOIL SERIES.

Concurrently with the soil survey, much attention was given to the distribution and collation of soil profiles of uniform characteristics. The definition of a soil series is given as "a group of soils having horizons similar as to differentiating characteristics and arrangement in the soil profile and developed from a particular parent material". Many soil series have been identified, but it is possible that the total number represented in the sugar belt will not exceed 40. The three Natal Regional Survey Reports dealing with the North Coast, South Coast and Zululand respectively have each dealt with known soil series and during the year a paper was prepared and submitted to the South African Technologists Association dealing with this subject. Owing to the anticipated importance of soil series in agronomic research, ways and means of preserving and identifying soil profiles in a natural condition were investigated. Considerable success resulted from this investigation and a number of recognised soil series have already been prepared for display purposes. See Plates 1 and 2.

PLATE 1.



Examples of prepared soil monoliths which are on display at the Experiment Station.

PLATE 2.

Technique employed in the taking of a soil series monolith from a bank of soil.

SOIL CHEMISTRY.

Analyses of the horizons of soil profiles have been continued with a view to the characterisation of the various soil series occurring within the industry. It has been found that considerable variation in natural soil fertility occurs between the various soil series, and analyses of this nature assist in extending our knowledge of the immediate fertility requirements as well as the reserves in the soil.

A preliminary investigation into humus was undertaken. Humus is a general term for that portion of the soil's organic matter which has become directly useful to plants in that it is a carrier of the elements of nutrition. Ordinarily in soils, this function is carried on by the clay fraction, but in soils where the amount of clay is low, as for example in a very large proportion of our soils, the addition of organic matter which breaks down to form humus, becomes an important supplement. The amount of humus in the soil is not necessarily directly related to the amount of organic matter (trash, roots, etc.) in the soil, since the breakdown of organic matter is governed by micro-organism which function at their best only when suitable conditions prevail. The great quantity of organic matter accumulated in mist belt soils, for example, does not necessarily imply very high humus content.

A start was made during the year with a technique to estimate the soil's supplying power of available nitrogen. It is hoped from a study such as this to throw light on certain characteristics of different soils, for example, the good response to nitrogen generally found in ordinary Table Mountain sandstone soils and the lack of response to this element in the Recent Sands, where it could also be expected.

SOIL MOISTURE.

This important phase of study has been continued, with special reference to the amount of water available to the plant in the various soil groups of the industry. Particular attention is now being given to the entire soil profile, since much of the plant's moisture needs is drawn from the sub-soil. Owing to the fact that many of our soils comprise an upper horizon completely different from the rest of the profile, erroneous information on moisture levels in these soils will result if the whole profile is not considered. Thus, while the Lower Ecca shale top soil has a relatively high available moisture content, these soils are usually a matter of inches deep and overlie decomposing rock, so that the amount of water actually obtainable by the plant is not very great. Conversely, the Recent Sands have a relatively low amount of available moisture, but this is compensated for by the fact that this soil extends to a considerable depth.

The importance of the study of soil-water retention studies, lies in the fact that it is of direct practical use in irrigation. Without fundamental information on the water retention properties of the various soils in the industry, the application of water to the soil cannot always be most economically exploited. In a paper published during the year and presented to the South African Sugar Technologists Association, basic information of this nature was published, as follows in Table I.

Table I

SOIL	D	FCw	FCv	FCi	WPw	WPv	WPi	Available Moisture Inches/Feet
1. Amphibolite	1.45	20.36	29.52	3.54	13.43	19.47	2.34	1.20
2. Tugela Schist	1.45	17.46	25.32	3.04	12.18	17.66	2.12	0.92
3. Granite	1.60	12.89	20.62	2.47	6.49	10.38	1.25	1.22
4. Table Mountain sandstone (Ordinary)	1.70	7.61	12.94	1.55	4.10	6.97	0.84	0.71
5. Table Mountain sandstone (Mist belt)	1.10	27.32	30.05	3.61	12.99	14.29	1.71	1.90
6. Dwyka tillite	1.65	16.67	27.51	3.30	6.24	10.30	1.24	2.06
7. Lower Ecca shale	1.40	27.62	38.67	4.64	12.53	17.54	2.10	2.54
8. Middle Ecca sediments	1.65	18.91	31.20	3.74	7.85	12.95	1.55	2.19
9. Beaufort sediments	1.60	7.15	11.44	1.37	4.33	6.93	0.83	0.54
10. Karroo dolerite (red)	1.40	30.32	42.45	5.09	18.69	26.17	3.14	1.95
11. Karroo dolerite (black)	1.40	34.63	48.48	5.82	21.45	30.03	3.60	2.22
12. Cretaceous sediments	1.35	47.33	63.90	7.67	29.23	39.46	4.74	2.93
13. Recent Sands (red)	1.60	4.72	7.55	0.91	2.43	3.89	0.47	0.44
14. Recent Sands (grey)	1.60	3.48	5.57	0.67	2.03	3.25	0.39	0.28
15. Alluvium (red)	1.55	15.68	24.30	2.92	9.17	14.21	1.71	1.21
16. Alluvium	1.35	47.61	64.27	7.71	28.67	38.70	4.64	3.07

D = *Natural Bulk Density of soil.*
FC = *Field Capacity in inches/ft.*
FCw = *Field Capacity % by weight.*
WPw = *Wilting Point % by weight.*
WPi = *Wilting Point in inches/ft.*
FCv = *Field Capacity % by volume.*
WPv = *Wilting Point % by volume.*

In addition, attention was drawn to the fact that the amount of available moisture in a soil may be directly correlated with its silt plus clay content :

	Coefficient of Correlation (r)	Regression Equation
Field Capacity vs % Clay	0.9015	—
Field Capacity vs % (Silt + Clay)	0.9485	$y = 0.07365x+0.2037$
Wilting Point vs % Clay	0.9548	—
Wilting Point vs (Silt + Clay)	0.9622	$y = 0.04528x-0.0891$
Available Moisture vs % Clay	0.7093	—
Available Moisture vs % (Silt + Clay)	0.8027	—

Considerable numbers of plaster of paris blocks to give a measure of the moisture content of the soil, were prepared and installed at various depths on an experimental site. Although this research is in an experimental stage as yet, it is hoped that by keeping track of soil moisture in the field by this method, that this data will help in the elucidation of field trials.

In conjunction with the Research Agronomist, plaster of paris moisture blocks made to the Hawaiian pattern were installed in the burning and trashing experiment BT 1/39.

The blocks were installed in one each of the four treatments of the experiment. These are burnt no fertilizer, trash no fertilizer, burnt plus fertilizer and trash plus fertilizer. Blocks were situated in the same hole at depths of 3, 6, 12, 24, 36 and 48 inches from the surface. The excavated soil was replaced in the form of a slurry in accordance with practice in East Africa. A period of over a month was allowed for the blocks to come to equilibrium. The blocks were calibrated to moisture tensions in the pressure plate and pressure membrane apparatus.

Daily readings of the blocks over an eight-month period are shown on the Figure I, together with daily rainfall and weekly growth increment.

FIGURE I

THE EFFECT OF BURNING, TRASHING AND FERTILIZER (Expt. BT 1/39) ON SOIL MOISTURE STATUS

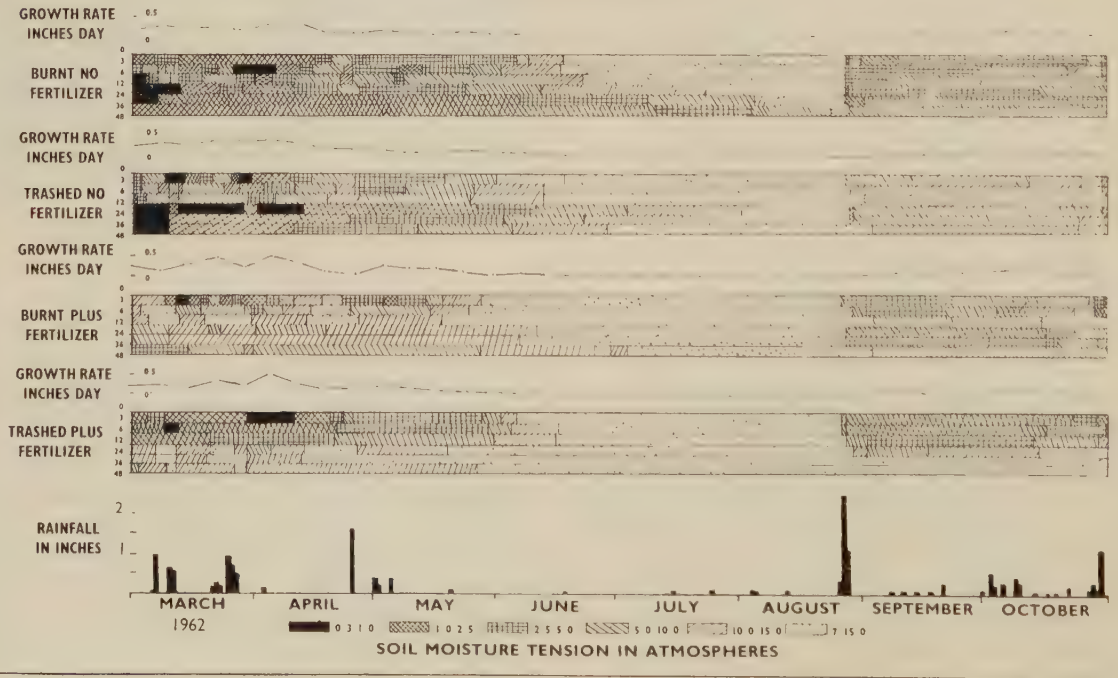
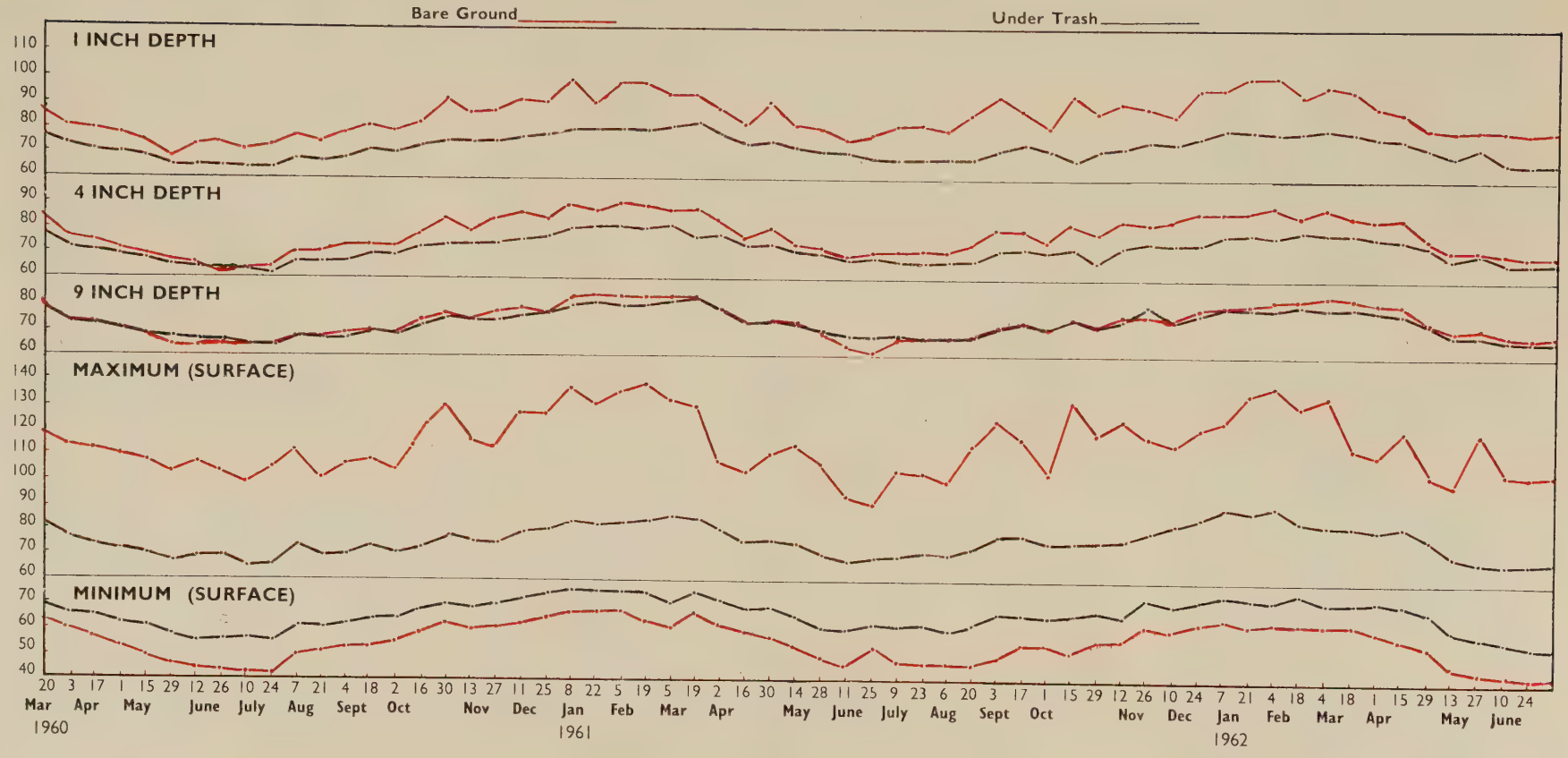


FIGURE II

BI-WEEKLY MEAN SOIL TEMPERATURES (F) ON BARE GROUND AND UNDER TRASH AT MT. EDGECOMBE


Bare Ground
Under Trash
1 INCH DEPTH
4 INCH DEPTH
9 INCH DEPTH
MAXIMUM (SURFACE)
MINIMUM (SURFACE)
20 3 17 1 15 29 12 26 10 24 7 21 4 18 2 16 30 13 27 11 25 8 22 5 19 5 19 2 16 30 14 28 11 25 9 23 6 20 3 17 1 15 29 12 26 10 24 7 21 4 18 4 18 1 15 29 13 27 10 24
Mar Apr May June July Aug Sept Oct Nov Dec Jan Feb Mar Apr May June July Aug Sept Oct Nov Dec Jan Feb Mar Apr May June
1960
1961
1962

Tentative conclusions which can be arrived at from this experiment are as follows :

1. Fertilization increases moisture uptake, whether cane has been trashed or burnt.
2. Growth rate reflects markedly the soil moisture status. A complicating factor is the low temperature over the winter period which corresponds to the period of maximum moisture stress. These low temperatures in themselves curtail plant activity.
3. It would appear that apart from the first twelve inches of soil depth, the overall moisture status does not vary to any great extent between the burnt and trash plots. In other words, a trash cover under cane does not appear to conserve moisture in the soil below a depth of 12 inches.

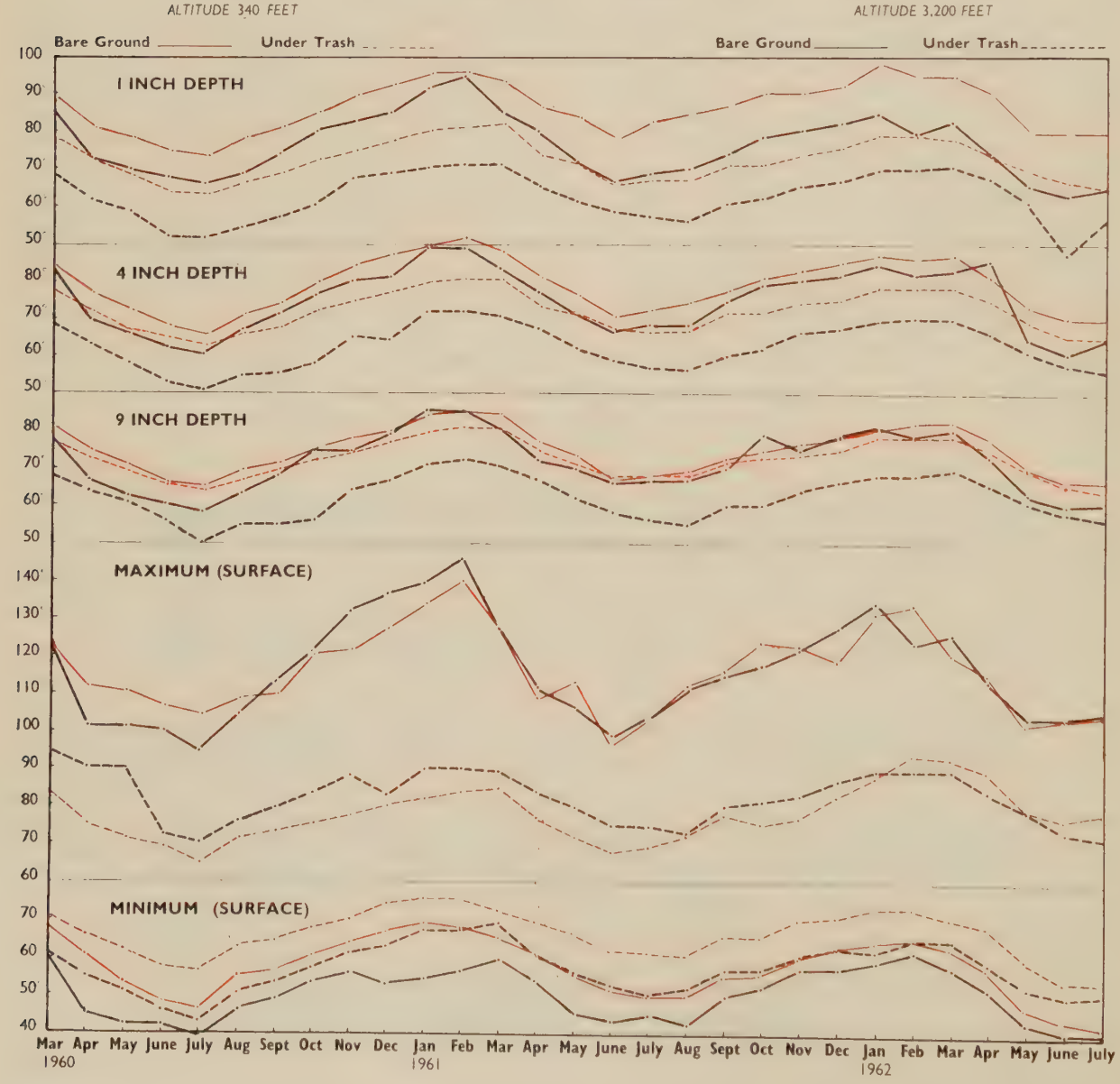
The method of placement of the blocks would not appear to be entirely satisfactory, as some anomalies have been found, for example after rainfall, lower levels give higher readings than higher horizons. This problem is to be investigated further.

SOIL TEMPERATURES.

Records commenced in 1960 on soil temperatures at a number of sites throughout the sugar

FIGURE III

Monthly Mean Soil Temperatures (F) From Two Centres within The Sugar Industry



belt and were continued throughout the year. Among points of interest which have arisen are the fact that temperatures under trash are decidedly lower and may even retard growth in certain parts of the industry (see Figure II). It was also found that there was only slight variation in overall temperature between the northern and southern extremities of the region, greater variations actually being found over small distances, mainly on account of aspect. The removal of trash in the cooler areas is beneficial in increasing temperatures, since the temperatures under trash in winter in those areas are very low. The difference in temperature between trash and bare ground at 9 inches depth over 1960-61 at Wartburg (altitude 3,200 feet), for example, was 10.2°F as against 2.5°F at Mount Edgecombe (see Figure III).

The number of recording stations throughout the industry has now been reduced to four strategically located centres. It is intended to continue these records as long as possible as they form an additional source of information on the growth of sugarcane within the industry.

Plant Nutrition

Chief Research Chemist: J. L. DU TOIT

WITH a decidedly low mean annual rainfall for sugarcane production without irrigation and with soils which are generally poor and particularly deficient in potash, crop production in South Africa is very greatly affected by rainfall and fertilizer usage. From 1951 to 1959 there was a period of rapid expansion with cane production rising from 4,805,249 tons to 9,123,396 tons. This exceptional increase in production was the result of a number of factors. It coincided with a very favourable rainfall cycle, an increase in the acreage under cane and better cane varieties; but a further most important contributory factor was the spectacular rise in fertilizer usage and in particular a realisation of the importance of potash in cane production on a very large proportion of soils. There was no restriction on production and the Industry realised that highly profitable increases in yields could be obtained from higher levels of fertilizer application.

Dangerous Decline in Fertilizer Usage.

Unfortunately overproduction followed this period of expansion and crop restriction has had to be instituted with the result that the consumption of fertilizer within the Industry fell sharply during 1960. This trend was continued in 1961 and less than half the fertilizer used in 1959 was consumed in 1961.

This drastic reduction has taken place without a corresponding decrease in acreage under cane. In fact the area under cane or area harvested has increased rather than decreased. Since the cane was certainly not over-fertilized in 1959, it follows that the amount of fertilizer now being applied is becoming dangerously low.

The trend of fertilizer usage is given in the tables I and II.

Table I

	1951	1955	1959	1960	1961
Tons mixed fertilizer	25,277	37,564	33,805	23,653	16,786
„ nitrogenous fertilizer	5,280	16,495	25,879	16,404	10,659
„ phosphatic fertilizer	15,297	8,470	17,419	15,959	11,119
„ potassic fertilizer	125	3,998	15,930	8,994	6,697
Total tons N.	2.135	5,856	11,324	7,344	4,706
Total tons P_2O_5	6,526	5,183	5,980	4,365	2,906
Total tons K_2O	842	4,564	12,721	7,810	5,991

Table II

	1951	1955	1959	1960	1961
Total tons cane	4,805,249	8,005,990	9,123,396	8,649,617	9,384,090
lbs. N per ton cane	0.89	1.46	2.48	1.70	1.00
„ P_2O_5 per ton cane	2.72	1.29	1.31	1.01	0.62
„ K_2O per ton cane	0.35	1.14	2.79	1.81	1.28

The fertilizer data here given were obtained from the Fertilizer Traders' Association and represent probably more than 75 per cent of the total fertilizer used in the Industry.

The amount of nitrogen used per ton of cane harvested is the lowest since 1951 and never before has less phosphate been used per ton of cane produced. The potash used, although slightly higher than in 1955, is probably even more inadequate than the other plant nutrients because potassium deficiency is now widespread within the Industry and at the present rate of usage the soil reserves must be lowered. Obviously the usage of fertilizer has reached such a low level as to be a real danger to future efficient production. The relative amounts of nitrogen, phosphate and potash used per ton of cane produced in 1961 are only respectively 40, 48 and 46 per cent of corresponding values in 1959. This unsatisfactory state of affairs is bound to have a marked effect on the yields in 1963.

Of the 11,119 tons of phosphatic fertilizer used in 1961, superphosphate and basic superphosphate represented 56 per cent and raw rock phosphate 34 per cent of the total, the remainder being mainly basic slag. Of the straight nitrogenous fertilizers used there were 3,997 tons of limestone ammonium nitrate, 3,759 tons urea and 2,846 tons sulphate of ammonia, with the result that urea represented more than 50 per cent nitrogen used in the Industry in 1961. Practically all potassic fertilizers used was muriate of potash.

Of the mixtures 10-6-10 remains the most popular, 7,251 tons being used out of a total of 16,786. Other mixtures used in excess of 1,000 tons within the Industry were 15-0-15 with 2,957 tons, 5-13-5 with 2,592 tons, 3-13-8 with 1,406 tons and 8-6-18 with 1,301 tons.

Excellent Potash Responses Revealed.

It has been found experimentally that the chances are very great of obtaining very substantial increases in yields of cane and sucrose per acre on soils containing less than 150 ppm exchangeable K_2O which corresponds to the equivalent of 500 lbs. muriate of potash in the top 6 inches of an acre of land and a very large proportion of our sugarcane soil falls into this category.

Of the present Regional Fertilizer Trial series, thirty-five experiments have now been harvested as both plant cane and ratoons. It was found that at planting only eleven of the sites had a potash content exceeding the limit denoted above. The responses to applications of potash in the other twenty-four trials were very good.

The average increases due to the application of 100 and 200 lbs. K_2O per acre i.e. 167 and 333 lbs. muriate per acre were respectively 0.83 and 1.24 tons sucrose per acre. In the ratoons the levels of potash applications were : 0, 150 and 300 lbs. K_2O per acre or 0, 250 and 500 lbs. muriate of potash per acre. The average responses amounting to 1.51 and 1.95 tons sucrose per acre. The fact that higher responses were here obtained in ratoons than in plant cane is probably due to the fact that in the ratoon the control plots had been further depleted in potash and that we are in fact dealing with an accumulated response to potash from plant cane to ratoons. With soils deficient in potash, there is generally an increase in sucrose per cent cane as a result of applications of potash. The results just discussed of course give the gains in an integrated form allowing for both cane yields and sucrose variations. If, however, a constant sucrose is assumed and a ratio of seven tons of cane to one ton of sucrose then these gains can be expressed in terms of tons cane per acre in the following table :—

Table III

	T.C.A.
Response due to 100 lbs. K_2O in plant cane	5.8
„ „ „ 200 „ „ „ „ „	8.7
„ „ „ 150 „ „ „ ratoons	10.6
„ „ „ 300 „ „ „ „	13.6

These experimental results on soils containing less than 150 ppm exchangeable K_2O, show the excellent responses which can be obtained. Here an application of 300 to 400 lbs. muriate of potash will prove highly remunerative while the lower rates now being applied with crop restriction will not only in time lower the yields per acre very appreciably but will lead to a further depletion of the already low soil reserves of potash.

However, where the potash content of the soil is in excess of 150 ppm exchangeable K_2O, responses are the exception and have only been found on very shallow soils. Of the thirty-five experiments here analysed, eleven had an exchangeable potash content higher than 150 ppm K_2O. Of these latter trials only one, situated on a very shallow lower Ecca soil, gave substantial responses to potash while in the majority of instances a slight although not significant depression in yield due to the application of potash was recorded. The average effect of potash on these eleven trials was that in plant cane a 100 lbs. per acre K_2O yielded 0.05 tons less sucrose per acre than the controls, and 200 lbs. K_2O per acre gave an increased yield of only 0.10 tons sucrose per acre. In ratoons the results were rather similar. Here on the average 150 lbs. K_2O per acre gave a loss of 0.20 tons sucrose per acre and 300 lbs. K_2O per acre a slight gain of 0.18 tons sucrose per acre.

If these results are now, as before, expressed in tons cane per acre, assuming 7 tons cane per ton of sugar we get :—

Table IV

	T.C.A.
Response due to 100 lbs. K_2O per acre in plant cane	— 0.4
„ „ „ 200 „ „ „ „ „ „ „	+ 0.7
„ „ „ 150 „ „ „ „ „ ratoons	— 1.4
„ „ „ 300 „ „ „ „ „ „	+ 1.3

In contrast to the excellent responses in soils deficient in potash, the responses here obtained to potash are negligible and uneconomic. It is most fortunate that we have a method of soil analyses that differentiates between these two categories fairly sharply. As pointed out in previous Annual Reports leaf analyses are also most useful in indicating responses to potash. It is therefore quite possible with the help of soil or leaf analyses to apply potash where needed and to get excellent returns and at the same time to avoid unnecessary expenditure on this plant nutrient where responses are doubtful and most likely to be uneconomic.

Nitrogen Responses.

It is generally concluded that responses to nitrogen are more general and larger in ratoons than in plant cane and consequently that ratoons need higher nitrogenous dressings than plant cane. The results from the recently harvested Regional Fertilizer Trials confirm these conclusions for some soil groups but not for others. Thus for Table Mountain sandstone soils including the mist belt soils where earlier experiments had shown the need for about 100 lbs. N per acre for plant cane, this series of experiments indicates on the average no further gains from higher applications in ratoons. Fifteen of these trials have now been harvested as plant cane and ratoons. There were no zero nitrogen plots. The levels of applied nitrogen were for plant cane 60, 120, 180 and 240 lbs. N per acre and for ratoons 100, 200, 300 and 400 lbs. N per acre. In plant cane the 120 lbs. N per acre out-yielded the 60 lbs. N per acre on the average by 0.42 tons sucrose per acre with no real further responses to higher quantities of nitrogen. In the ratoons the 200 lbs. N per acre gave on the average only 0.07 tons sucrose per acre more than the 100 lbs. N and it is known from other experiments that ratoons respond well to 100 lbs. N per acre on these soils. It therefore appears likely that in these soils 100-120 lbs. N per acre will suffice for both plant cane and ratoons. Occasionally, however, responses are obtained to higher levels of nitrogen.

Soils derived from granite were given the same nitrogen dressings as the T.M.S. group, but an insufficient number of experiments was dealt with and no definite conclusions can be drawn. There seems, however, a distinct possibility that ratoons may benefit from higher nitrogenous dressings.

In the case of all other soil groups the dressings were 0, 50, 100 and 150 lbs. N per acre for plant cane and 0, 100, 200 and 300 for ratoons. In the limited number of grey Recent Sands and soils derived from red dolerites, the responses in plant and ratoons were rather indifferent. The other soils showed only a moderate response to nitrogen in plant cane and often no response at all, but almost without exception excellent responses were obtained in the ratoons and here an amount of nitrogen in excess of 100 lbs. N per acre may often prove economical. In this latter category another fifteen experiments have thus far been harvested as plant cane and ratoons. The results of these trials converted from tons sucrose per acre to tons cane per acre assuming once again seven tons of cane to one ton of sucrose are as follows :

Table V

	T.C.A.
Response to 50 lbs. N per acre in plant cane	2.9
„ „ 100 „ „ „ „ „ „ „	4.9
„ „ 150 „ „ „ „ „ „ „	5.7
„ „ 100 „ „ „ „ „ ratoons	12.0
„ „ 200 „ „ „ „ „ „	15.1
„ „ 300 „ „ „ „ „ „	16.4

Although soil and even leaf analyses have not thus far proved of great practical value in assessing nitrogen responses with us a knowledge of the experimental results obtained on particular soil groups enables us to guide nitrogen fertilization with a reasonable degree of certainty.

Zinc Deficiency in the Cane Belt.

Leaf and total cane analyses have revealed a rather low zinc content in certain areas and apparent zinc deficiency symptoms have also been noticed in citrus and maize crops. Problem fields in the mist belt area of Upper Tongaat and Doornkop had failed to give the expected yield increases from nitrogen, phosphate and potash applications. The cane remained very poor in

these areas and although all the characteristic zinc deficiency symptoms were not apparent, the cane was rather yellow with a decided tendency to develop anthocyanin pigmentation. It was therefore decided to establish observation plots on four estates in the affected area and to try out the effect of zinc sulphate on the growth of cane.

The zinc sulphate was applied in the furrow, as a top-dressing, or as a spray on the foliage. For furrow applications and top-dressings, 50 lbs. zinc sulphate were applied per acre and in the spray applications some 15 gallons per acre of a 0.2 per cent solution of zinc sulphate were applied on the young cane plants.

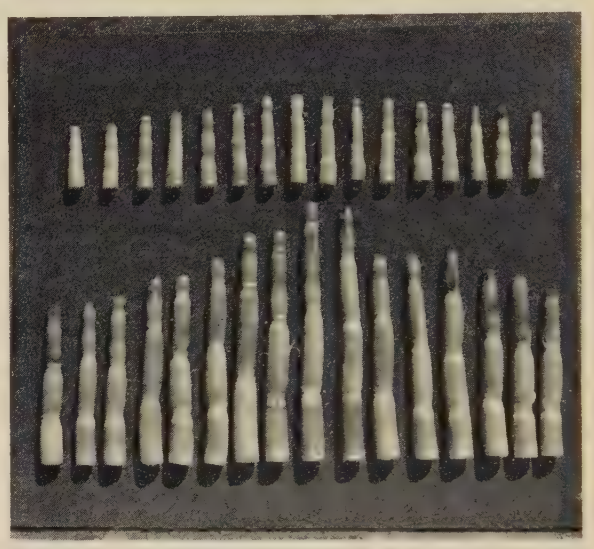
PLATE 1.

Cane on left untreated. Cane on right had a top dressing of 50 lbs. per acre Zinc Sulphate four months previously.

A positive growth response was obtained on all four estates. In the two instances where top-dressings, sprays and furrow dressings were tried, the furrow applications gave the best response. Spray applications gave the quickest visual response but the effects were not so lasting as the heavier furrow or top-dressing applications.

The effect of the zinc applications was to increase the growth and the tillering of the cane to a marked degree and where applied to growing, affected cane, to restore the healthy green colour of the foliage. The latter change was quite pronounced three weeks after a spray application of zinc sulphate. In one instance the total number of cane shoots in a 10-yard line of cane was increased from 70 to 125 as a result of a zinc application in the furrow.

PLATE 2.



The top nodes and internodes are from cane grown without zinc, while the bottom ones are comparable in all respects but were from cane grown with 50 lbs. per acre Zinc Sulphate.

The cane (N:Co.331) illustrated in Plates I and II was about one year old. At the age of eight months, its growth was greatly depressed. Part of the cane was then top-dressed with 50 lbs. zinc sulphate which was worked into the soil. The results were most spectacular. Not only was the colour of the cane largely restored and elongation markedly increased, but in the treated plot many vigorous bull shoots were formed, these being practically non-existent in the untreated cane. It is to be remembered that the difference in the height of the cane in Plate I is due to the effect of the zinc sulphate over a period of four months only. Plate II gives a better idea of the increased growth that resulted from the zinc application, for here we have the same number of nodes grown with and without the application of zinc sulphate.

The following analytical results were obtained four months after zinc application and all refer to ppm Zn on dry matter.

	Control	Zinc Treated
Third leaf laminae	5.5	10.0
Top cm. from growing point	60.0	130.0
Top 3 nodes and internodes	6.5	12.5

These observation trials were carried out on mist belt soils in areas of very depressed growth and establish the fact that under these conditions excellent responses to zinc can be obtained. It

is still to be ascertained how wide-spread zinc deficiency is in the cane belt and how general zinc responses are in the area tested i.e. the mist belt soils.

Deterioration of Burnt Cane.

During the year some most devastating fires swept the canebelt and great losses were suffered. The question of deterioration of burnt cane therefore became of great interest and experiments were carried out at the Experiment Station to compare the deterioration of cane which had been either burnt and cut, trashed and cut, and burnt and left standing. On the 28th November, 1961, a portion of a field of N:Co.339 cane was burnt and some of the burnt and unburnt (trashed) cane was cut the same day. Samples of the cut cane were weighed, left exposed to prevailing weather conditions and analysed periodically. The results of analyses were compared with those of freshly cut, burnt and unburnt cane. The results were as in Table VI.

Table VI

Date Analysed	No. of days since cut	Sucrose per cent cane				Purity of Juice			
		Trashed cane freshly cut	Trashed cane cut 28/11/61	Burnt cane freshly cut	Burnt cane cut 28/11/61	Trashed cane freshly cut	Trashed cane cut 28/11/61	Burnt cane freshly cut	Burnt cane cut 28/11/61
28/11/61	0	16.01	16.01	16.01	16.01	91.4	91.4	91.4	91.4
1/12/61	3	15.81	15.31	13.44	14.71	91.5	86.8	87.8	88.3
4/12/61	6	15.98	15.51	13.45	15.66	91.3	83.1	86.5	84.7
6/12/61	8	15.16	14.42	11.43	13.15	92.1	81.8	84.0	78.3
8/12/61	10	15.84	14.06	11.32	13.92	91.1	79.5	81.0	79.4
11/12/61	13	16.61	13.98	11.70	12.35	92.0	76.1	82.7	66.8
13/12/61	15	15.75	13.97	10.79	11.51	91.2	75.8	77.4	64.8
15/12/61	17	15.88	12.44	9.05	10.07	91.8	73.4	70.3	61.0

From the weight taken it is possible to assess both the percentage weight loss and the percentage sucrose loss of the cane cut on the 28th November. This was however not possible with any degree of accuracy for the cane left standing. In the following table these losses are recorded.

Table VII

Date Analysed	No. of days since cut	% of original weight		% of original sucrose	
		Trashed cane cut 28/11/61	Burnt cane cut 28/11/61	Trashed cane cut 28/11/61	Burnt cane cut 28/11/61
28/11/61	0	100.0	100.0	100.0	100.0
1/12/61	3	98.8	98.2	94.5	90.2
4/12/61	6	95.3	92.1	92.3	90.1
6/12/61	8	95.3	90.8	85.8	74.6
8/12/61	10	93.7	89.6	87.8	77.9
11/12/61	13	90.9	82.5	79.4	63.6
13/12/61	15	90.4	83.8	78.9	60.2
15/12/61	17	91.2	81.3	70.2	51.1

The burnt cane dried out more rapidly than the trashed cane and its percentage loss of sucrose was also greater. For the first week the sucrose per cent cane for the two treatments was rather similar, but with more drying out taking place in the burnt cane its percentage loss of sucrose exceeded that of the trashed cane. Thereafter the difference between the two treatments became even more marked. During the first week the purity of burnt cut cane was perhaps slightly better than that of the unburnt cut cane but if left for a longer period it became decidedly worse. The deterioration of the cane apparently also resulted in a loss of brix and consequently a purity drop does not necessarily reveal the full extent of deterioration.

The burnt cane which was left standing had a much lower sucrose per cent cane and brix than the fresh unburnt cane or cut burnt cane. This is presumably the result of dilution due to the uptake of moisture. Judged on purity, however, the burnt cane left standing did not deteriorate as rapidly as the cut cane. It is undoubtedly better in the event of a fire to leave the burnt cane standing until it can be transported rather than to cut it immediately; but even so an overall loss of some 10 per cent of the sucrose originally present must be expected after about a week. The possible rapid fall of the sucrose per cent cane due to dilution can be a further severe disadvantage where transport costs are high.

Factors influencing Starch in Sugarcane.

An investigation into the starch content of cane and factors influencing it, revealed that the nodes contained $3\frac{1}{2}$ to 4 times more starch than the internodes. It therefore follows that any factor that makes for better growth with the resultant longer internodes is likely to lower the starch content of the whole cane plant. Thus it was found that irrigation decreased the starch content of cane and the same applied to applications of nitrogen and potash where yield responses were obtained.

It is interesting, however, to note that for similar yield responses the decrease in starch content is appreciably greater in the case of potash applications than for nitrogen. It seems that quite apart from altering the nodal to internodal ratio, potash has a lowering effect on starch in the different tissues themselves. There was a very marked difference in the high starch content of cane grown on potash deficient soils and the low starch content of cane grown on soils high in potash content.

Starch is largely concentrated in the top 2 or 3 feet of cane and starch to sucrose ratio in the top 6 inches of cane is very high. Adequate topping of cane will therefore have an appreciable effect in lowering the starch to sucrose ratio.

In cut cane there appears to be enzymatic breakdown of starch to glucose and there is a gradual decrease in the starch concentration of the expressed juice up to 5 to 6 days after cutting the cane. Thereafter the decrease is much more rapid and this applies to both granular and total starch. After 8 to 10 days the granular starch per cent brix may fall to only one fifth of the original figure.

Great differences were found in the starch content of different varieties. The *S. officinarum* and *S. robustum* varieties were found to be exceedingly low in starch content. *S. sinense* varieties are high and *S. barberi* very high in starch, but the *S. spontaneum* varieties are most variable, their starch content ranging from low to extremely high. Of the commercial varieties now being grown, N:Co.310 was found to be the highest in starch, followed by N:Co.292 and then an intermediate group consisting of N:Co.293, N:Co.334, N:Co.339, N:Co.376 and Salvo. Co.331 had the lowest starch content of the varieties now commonly grown. Samples of P.O.J.2725 and P.O.J.2878 had a very low starch content. It is interesting to note that although N:Co.310 usually had a very high starch content, quite low starch concentrations were found in this variety in a few instances where the variety was grown on alluvial soils very high in potash.

Distribution of Azotobacter.

It was thought that the presence or absence of nitrogen fixing bacteria may offer some explanation for variations in responses to nitrogenous fertilizers and consequently a preliminary survey of Azotobacter in the sugarcane soils of Natal was made. It was found that there was, in general, a fairly high incidence of Azotobacter in the soils. The acid soils derived from Table Mountain sandstones were however very often devoid of Azotobacter and the low pH may well be the reason for this being so. Soils derived from Dwyka and Lower Ecca shale were however also found low in Azotobacter and here the same explanation does not hold. The incidence of Azotobacter was high in soils derived from the Beaufort formation, schists and dolerites as well as in Recent sands and alluvials.

As was to be expected there was a good correlation between pH and the incidence of Azotobacter. Of the soils with a pH of 6.0 or higher 87 per cent were found to be Azotobacter positive whereas with soils of pH below 5.5 only 21 per cent contained Azotobacter. The intermediate group i.e. soils of the range of pH 5.5-5.9 had an Azotobacter positive percentage of 53.

There were strong indications that soil compaction severely limits the incidence of Azotobacter in heavy soils.

Cultural Practices

Chief Agricultural Officer : C. H. O. PEARSON

Research Agronomist : G. D. THOMPSON

AGRICULTURAL TRIALS.

FURTHER data collected from the transpiration tanks have confirmed the findings of the previous year. The cumulative data from the Experimental Farm, Chaka's Kraal, is shown in Table I.

Table I

	Plant cane 12 mths.	1st Ratoon 10½ mths.	Total 22½ mths.
t.c.a.	61.61	67.31	128.9
t.s.a.	7.97	7.26	15.23
Total water (in.)	77.09	81.27	
Leachate (in.)	23.12	37.21	
Consumptive use	53.97	44.06	98.03

PLATE 1.

The effects of deep planting on stool formation in plant cane. The sett was planted in a sandy soil in a deep furrow which was prematurely filled in by wind and rain action.

The consumptive use of water in the ratoon followed the same pattern as in the plant cane crop and reached maximum requirements of approximately 7″ over a 28-day period in February, falling to a minimum between 2″ and 3″ for a 28-day period in July.

The field of approximately 0.6 tons sugar per acre per month obtained in this experiment would be rated very high by any standards in any sugar producing country and serves to emphasise yet again the supreme importance of water in crop production in Natal.

Figure I gives the details of the lysimeter tank installations.

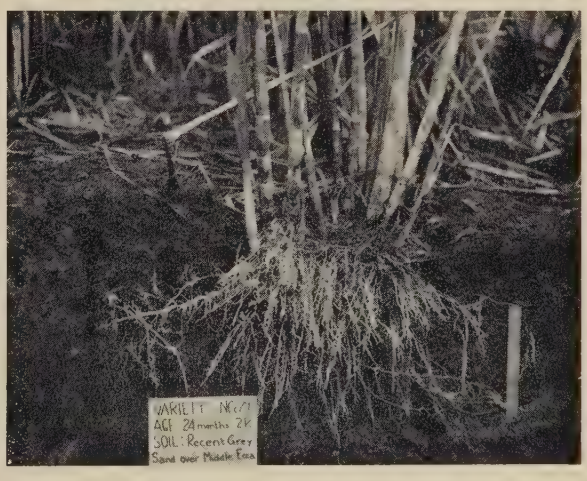
COSTS OF RE-ESTABLISHMENT.

Results from a trial planted in 1959 and reaped during the current season indicated that considerable savings could be affected in the costs of re-establishing a cane field without there being any significant effect upon final yield of crop.

The treatments in the sequences indicated were as follows :

T1 Control. (a) ploughed, (b) disc harrowed, (c) ploughed, (d) disc harrowed, (e) furrowed (½ area deep furrowed, ½ shallow), (f) fertilized — by hand in furrow, (g) planted — by hand. These operations are

PLATE 2.



Excavated stool of a mature second ratoon cane plant. Note that all shoots originate at about 4-6 inches below ground level despite the original sett having been planted in a furrow at least 9 inches below ground level.

order to assess what further information is required :

1. Trash management
2. Spacing
3. Weed control
4. Irrigation.

A brief report on 1, 2 and 3 follows. At the time of writing, 4 is incomplete.

1. TRASH MANAGEMENT.

The general conclusions which can be drawn from the results of the nine experiments conducted to date investigating the effects of various forms of trash management and comparing these with burning trash, are as follows :

(a) A trash blanket is in average circumstances worth approximately 3½ tons of cane per acre in the succeeding ratoons in comparison with burning each crop before harvesting.

(b) Under conditions of poor drainage, a trash blanket depresses yields.

(c) At high altitudes the benefits of a trash blanket noted in (a) may be nullified.

(d) The presence of a trash blanket enhances the efficacy of N and K top-dressings.

(e) There is no real evidence to suggest that phosphate uptake is enhanced by applying phosphatic fertilizers on top of trash.

(f) The uptake of phosphatic fertilizers is greatest when they are applied in the furrow.

The actual conditions under which trash does give a response when compared with burning in ratoons have not been accurately established, nor have the causes for the response been identified.

Further work to obtain information on various aspects of crop and soil conditions which appear likely to be affected by the presence or absence of trash (see Table) is now projected.

Plant Condition	*Associated Soil Condition*	*Possible associated conditions affected by trash*
Moisture content	1. Available moisture content	1. Moisture holding capacity 2. Infiltration rate 3. Percolation rate 4. Evaporation losses 5. Runoff losses
Nutrition	2. Available nutrients	6. Exchange capacity 7. Release from organic compounds 8. Rate of nutrient release 9. Interaction, N x soil moisture x time
Growth	3. Soil climate and structure	10. Soil temperature 11. Soil structure 12. Soil porosity
Yield	1, 2 and 3	1 — 12 inclusive

2. SPACING.

Of the nine experiments conducted on plant populations in Natal, three concern within-row or sett spacing only, one concerns both within-row and between-row spacings and five concern between-row spacing only. Other factors considered in various experiments were variety and levels of nutrition.

The following general conclusions may be drawn from the results obtained to date :

(a) The continuous or end-to-end planting of setts in the furrow is economically justifiable.

(b) Under irrigation and in areas of adequate rainfall or soil moisture there is a marked and consistent increase in yield due to closer between-row spacings down to 18″.

(c) Under drier conditions this trend may be reversed.

(d) There is no demonstrable interaction between row spacing and variety or level of fertilization.

The following questions remain unanswered :

(a) Whether a more intensive rate of planting than end-to-end placement of setts is economically justifiable ?

(b) What is the identity of factors causing inconsistent results under dryland conditions ?

(c) What are the conditions under which positive responses are obtained in terms that have any practical significance and what is the nature of the crop growth factors which produces them ?

3. WEED CONTROL.

Experiments on weed control have been conducted since 1931 and are continuing. The conclusions which may be drawn from past work are as follows :

(a) Weeds, on the average, may cause a 50 per cent reduction in cane yields and might cause even greater reductions of up to 75 per cent under certain conditions.

(b) Provided that weeds are adequately controlled there is no proof of any significant difference in effect attributable to the method of control, whether it be by hand or by mechanical implement.

(c) Herbicides at relatively high levels of application may suppress cane yield and there appears to be a differential varietal susceptibility in this respect.

(d) Under certain specific conditions weed control by herbicides has been shown to be possible.

(e) The important aspect of weed control, particularly by means other than with herbicides appears to be that of timing in relation to the stage of development of both cane and weeds. Early weeding has been shown to be most essential.

While certain aspects of weed control constitute part of the research programme proper, the screening of herbicides is now being undertaken on a routine basis with particular reference to efficacy and cost. The most promising herbicides from the screening trials will be tested in future in simple field trials spread over a wide range of soil conditions, climate and weed populations throughout the canebelt. This procedure is essential in view of the widely divergent conditions to be found in the canebelt and the relatively prescribed conditions under which many formulations appear to be effective.

The first screening trial is reported fairly fully here to indicate the scope of the tests and the kind of results emerging.

DESIGN : The experiment was divided into three parts as follows :

Part I — Pre-emergent treatments.

	Cost of chem. per acre
1. Control—no treatment	—
2. Potassium salt of M.C.P.A., 6 pts/acre	R 2.21
3. Amine of 2,4-D, 5 pts/acre	1.84
4. Esters of 2,4-D, 6 pts/acre	2.21
5. C.M.U., full cover, 4 lbs./acre	12.20
6. D.C.M.U., full cover, 4 lbs./acre	12.20
7. Simazin, full cover, 4 lbs./acre	8.60
8. Eptam, full cover, 5 pts/acre	14.40
9. Fenac, full cover, 10 pts/acre	11.40
10. C.M.U., row only, 1 lb./acre	3.05
11. D.C.M.U., row only, 1 lb./acre	3.05
12. Simazin, row only, 1 lb./acre	2.15
13. Eptam, row only, 1¼ pts/acre	3.60
14. Fenac, row only, 2½ pts/acre	2.85

Part II — Post-emergent contact treatments.

1. Control—no treatment	—
2. P.C.P., 4 galls. per acre	1.96
3. *Reglone, 2 pts. per acre	3.75
4. *Paraquat, 4 pts. per acre	12.00 *(provisional)*
5. Geeltox, 12 pts. per acre	6.45
6. Stam 34, 1½ U.S. galls/acre	3.00
7. P.C.P. + 2,4-D Ester, 2 galls + 3 pts/acre	2.09

Part III — Post-emergent, Total or systemic treatments.

1. Control—no treatment	—
2. T.C.A., 15 lbs./acre	4.50
3. *Dalapon, 7½ lbs./acre	7.87
4. Weedazol, 2 galls/acre	17.60
5. P.C.P. + T.C.A. + 2,4-D, 2 galls + 7 lbs + 3 pts/Acre	4.19

PLATE 1.

Control treatment 32 days after planting.

PLATE 2.

C.M.U. Pre-emergent treatment 32 days after planting.

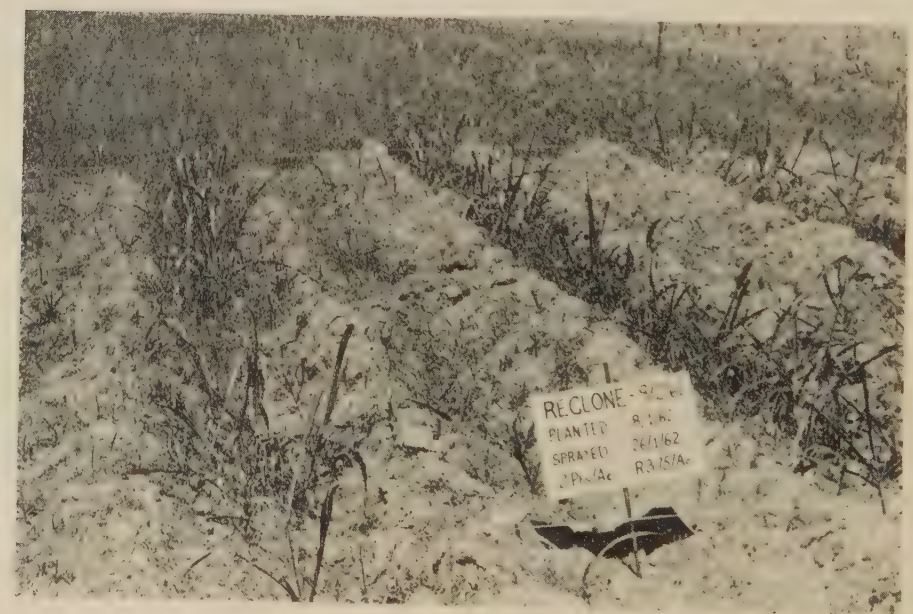


PLATE 3.

Reglone treatment 14 days after spraying, 32 days after planting.

PLATE 4.

Eptam "row only" treatment 32 days after planting.

PLATE 5.

Paraquat treatment 33 days after spraying, 51 days after planting.

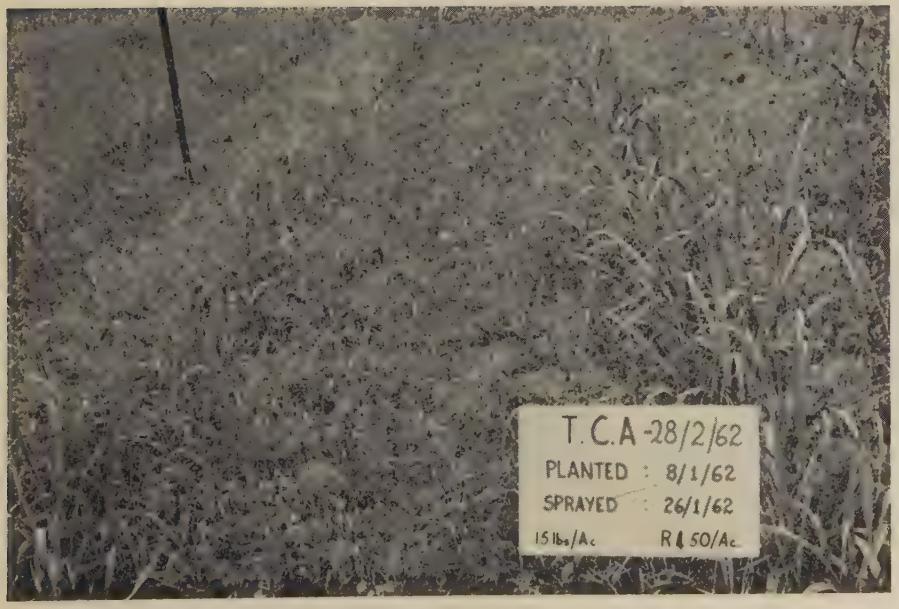


PLATE 6.

T.C.A. treatment 33 days after spraying, 51 days after planting.

* *These treatments included 0.1% vol./vol. wetting agent Agral 90.*

There were four replications of all treatments in random block designs. The plots were 1/100th acre in size, there being five rows per plot, 4 ft. 6 ins. apart and 19 ft. 4 ins. in length.

RESULTS: The experiment was entirely observational and visual ratings of the relative effects of the treatments on weeds and cane were made by four observers on 9th February, 1962, approximately one month after planting and two weeks after the post-emergent applications had been made.

The systems of rating were as follows:

A: Weed Control: 0 = No weed control to 9 = Complete weed control

B: Effect on Cane: 0 = Complete suppression of cane to 9 = No supression of cane.

B_1 in the results for Part I refers to a second rating conducted on the condition of the cane on 28th February, 1962, about 7 weeks after planting and two weeks after all plots had been scarified, and all but the C.M.U., D.C.M.U. and Eptam plots hand weeded in the row.

Since both row and full cover treatments were included in the experiment, the ratings were based on the growth of weeds in the furrow only. The average results are shown below, each figure being the mean of sixteen observations.

Part	*Treatment*	*A*	*B*	B_1
I	Control	0	5	4½
	2,4-D Amine	2	6	5½
	2,4-D Esters	2	6	6
	Fenac, full cover	2	7	6½
	Simazin, row only	2	6	8
	Fenac, row only	2	6	6½
	M.C.P.A.	3	7	7
	Simazin, full cover	5	7	8
	D.C.M.U., row only	5	7	8
	C.M.U., full cover	7	8	9
	C.M.U., row only	7	8	8
	Eptam, row only	7	4	3
	D.C.M.U., full cover	8	9	9
	Eptam, full cover	8	2	1½
II	Control	0	3	
	P.C.P.	2	4	
	P.C.P. + 2,4-D Esters	2	5	
	Stam 34	3	5	
	Geeltox	4	6	
	Reglone	5	7	
	Paraquat	6	7	
III	Control	0	4	
	T.C.A.	2	4	
	Dalapon	2	4	
	Weedazol	3	5	
	P.C.P. + 2,4-D + T.C.A.	3	5	

The rainfall for the period over which the experiment was conducted is given below:

Date	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Jan.	.09	—	—	—	.12	—	—	—	1.10	.29	—	—	—	.12	.33
Feb.	—	.03	—	.37	—	—	—	—	.05	.04	—	—	.84	.60	.07
Mar.	—	—	—	—	—	—	—								

Date	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Jan.	1.14	—	—	.32	.18	—	—	—	—	—	.08	—	—	—	.04	—
Feb.	—	—	.09	.04	—	—	.14	—	—	.03	—	.18				

Those treatments giving adequate weed control, while not affecting the cane, and approximating in cost to other forms of weed control were: C.M.U. (row only) at R3.05 per acre, D.C.M.U. (row only) at R3.05 per acre, and Reglone at R3.75 per acre. Paraquat may also be added to this list but the cost at time of reporting was uncertain.

It may be noted that the main weed species on the site was *Cyperus esculentus*, presumably grown from rhizomes since the pre-emergent hormone herbicides were singularly ineffective. Further the rainfall distribution during the course of the experiment was such as to favour D.C.M.U. and C.M.U., herbicides which have previously not been found to be particularly

effective under Natal conditions. Of interest was the effect of Eptam which at the rate applied gave outstanding control of the "water grass" (Cypreus sp.) but severly checked cane growth (see plates). It is possible that at lower rates and under drier conditions this herbicide may have a less drastic effect on the cane while maintaining its effectiveness.

The results obtained with Reglone and Paraquat are particularly encouraging since both appear to have characteristics which overcome the limitations of P.C.P. in that they are easily mixed, remain dispersed and are to some extent translocated in the plant so as to give a good kill even when the area of contact on the foliage is limited.

PLANT COMPOSITION IN RELATION TO SOIL TEMPERATURES.

It has usually been assumed that the lower moisture per cent green matter and the greatly reduced growth of cane amounting to virtual cessation observed in winter in Natal, even when it is grown under irrigation, was due to the low soil temperatures prevailing at this time of the year.

Attempts were made this year to ascertain whether this assumption was correct by growing in a greenhouse, stools of cane, (a) in soil at normal temperatures and (b) in soil artificially maintained at 10°-20°F below normal. The experiment was conducted over a period of 33 days between 10th May and 12th June, 1962, during which the mean soil temperatures for the two soils were as follows :

Mean Soil Temperatures :

8 a.m.	Warm	62.3°F	Range	57-70°F
	Cold	50.8°F	,,	43-61°F
3 p.m.	Warm	82.8°F	,,	73-98°F
	Cold	61.7°F	,,	51-74°F

The following observations can be made from results obtained :

1. The moisture contents of both stem and leaf expressed as percentages, are lower in cane grown in *cold* soil.
2. A lower growth rate as measured by stem elongation was shown by cane grown in *cold* soil.
3. The sucrose content was higher in the cane grown in *cold* soil.
4. The estimated sucrose per cent fibre was higher in cane grown in *cold* soils.
5. The purity of the juice was only slightly higher in the cane grown in *cold* soil.
6. The estimated average amount of sucrose per stalk was slightly higher in the cane grown in *warm* soil.

It may be tentatively concluded from the foregoing that :

1. the dry weight of cane plants grown in warm soils is higher than that of plants grown in cold soils;
2. the additional dry weight of plants grown in warm soil is the result mainly of the formation of additional fibrous material.
3. Since photosynthesis apparently has at most been only slightly inhibited by the cold soil, while stem growth has been distinctly retarded, the lower moisture content of the plant grown in cold soil expressed as percentages must be due at least in part to their higher sucrose accumulation/stem growth ratio.
4. The higher moisture content per cent dry matter (see 2 above) in cane grown in warm soil suggests that there is a real expression of moisture deficiency in the cane grown in cold soils and that this might be the cause of the growth inhibition.

The experiments now in progress with sugar cane are shown in Table III.

COMPLEMENTARY CROPS.

The work on complementary crops was carried out on a co-operative basis with the Natal Region of the Department of Agricultural Technical Services. Three fertilizer and three variety trials were laid down to cotton but due to poor germination no reliable results have been obtained from these. Under the same scheme a lucerne trial testing fertilizers and trace elements was established at Chaka's Kraal as were two fertilizer plots to pastures with Paspalum. These with two other pasture trials on Planters' lands are continuing satisfactorily and will be continued over 2 or 3 seasons after which the results will be available.

Soya beans, coffee nursery beds, and pyrethrum nurseries were grown for the Department whilst the annual maize breeding plot was again planted to experimental crosses

Besides the work for the Department certain observational trials were carried out on cotton to gain experience of this crop and to examine the commercial possibilities of the crop in the cane belt. Seventeen co-operative sites of five acres each were planted to the variety Loco and 16 acres of Albar 637 were planted on Experiment Station land to help in the bulking up of seed of this variety which is resistant to the disease Black Arm.

Table III

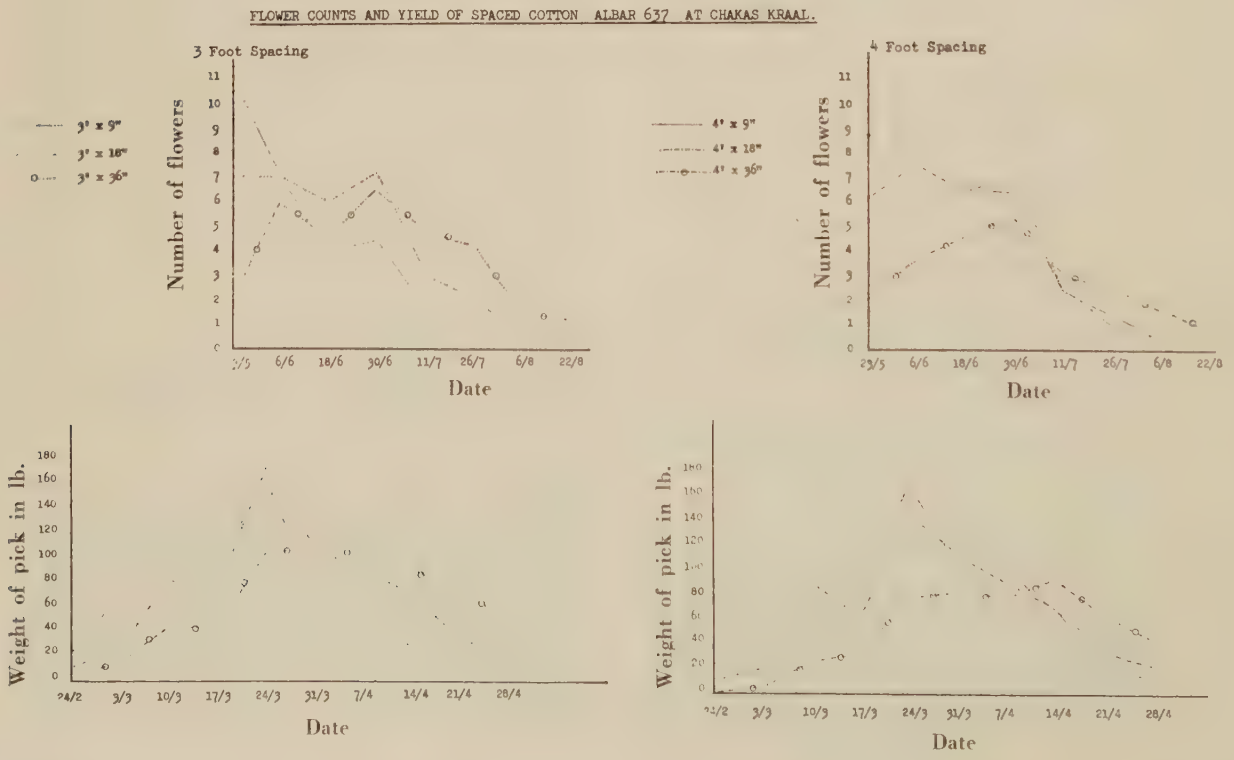
TRIALS IN EXISTENCE, SAMPLED AND HARVESTED IN THE CANE BELT DURING 1961-62.

TYPE OF TRIAL	R.F.T.		Exploratory Fert.		Fertilizer		Agronomic		Variety		Pest		Disease		No. of trials and Plots		Grand Total
Position and Supervision	Managed	Harvested	Managed	Harvested	Managed	Harvested	Managed	Harvested	Managed	Harvested	Managed	Harvested	Managed	Harvested	Managed	Harvested	
							No.	of	Trials								
Zululand :	—	8	—	1	—	4	1	2	2	2	1	2	—	—	4	19	23
North Coast :	—	5	—	—	4	5	—	—	2	5	2	4	5	—	13	19	32
South Coast :	1	3	1	—	2	1	—	—	1	2	—	—	—	—	5	6	11
Mtunzini Propagation Farm :	—	—	—	—	—	—	2	—	9	5	—	—	—	—	11	5	16
Chaka's Kraal Exp. Farm :	—	—	—	1	1	2	6	8	—	4	—	—	1	—	8	15	23
Mt. Edgecombe Exp. Stn. :	—	—	—	—	—	—	3	3	—	—	—	—	—	1	3	4	7
Outside S.A.S.A. Observers :	3					—	—	—	35	—	—	—	—	—	38	—	38
Total Exp. in Groups :	20		3		19		25		67		9		7				150

Environment Sites.	Micro Lines		Micro Plots		Variety Trials	
Illovo Sugar Estates :						
Powers Court	2	1	2	—	2	—
Amanzimtoti	2	—	1	—	2	—
Tongaat Sugar Co. Ltd :						
Mwawine Section	2	1	2	—	2	—
Umhlatuzi Valley Sugar Ests.	2	1	1	1	2	1
Chaka's Kraal Experimental Farm	1	1	1	1	—	1

Single Stools—Experiment Station :	40,000
	40,000
	80,000
Single Lines—Mtunzini :	1,614
	1,765
	3,379

FIGURE 2.



To make full use of the area under cotton, observation trials on the spacing of cotton and the type of jet to be used for the insecticide control were tried out.

The results on spacing are given in Figure 2 showing the period over which flowering and picking took place. The yields at the various spacings differed little, all being in the region of 1,600 lbs. seed cotton per acre. The effective end of harvest however was 2 to 2½ months earlier with the close within-row spacings than with the wide within-row spacings, and 10 days earlier at 3 ft. than 4 ft. inter-row spacing with the same within-row spacing of nine inches.

The flower counts are directly related to the harvest times and show the peak and rapid drop of the main flush.

The relative merits of two forms of jets for applying the insecticide sprays were tested, the finer Tee-jets giving an increased yield of 409 lbs. of seed cotton per acre presumably as a direct result of better coverage. The Tee-jet booms use only 15 gallons of spray per acre compared with the ceramic jets which use at least 35 gallons per acre.

Of the seventeen 5 acre co-operative plots only a few yields and costs have as yet come to hand.

From the information available it would appear that an average yield of 1,400 lbs. of seed cotton per acre has been obtained. The highest reported yield for 1961-62 has been 2,100 lbs.

The net profit figures range from R10 per acre to R110 per acre with an average net profit of R39 per acre. The cost of insecticide spraying has varied considerably ranging from R18 per acre to R34 per acre according to the length of period during which spraying continued. This operation was often continued for longer than was necessary to establish the yields obtained. Picking costs also varied considerably and were often excessive due to putting the pickers too frequently into small pickings.

Cotton would, from the observations made in 1961-62, be a very suitable and profitable crop to grow on land being fallowed between cane crops.

Cane Varieties

Plant Breeder : P. G. C. BRETT

THE PRESENT VARIETY POSITION.

THE N:Co. varieties now hold the field, with Co.331, the last of the Co. varieties, on its way out, and Salvo (N.50/211) the first of the Sa varieties, on its way in. N:Co.310 continued as the foremost variety. However, its contribution of 55.65 per cent of the total crop indicated for the first time a definite decline in popularity. It is interesting in this connection to note that in some other countries, such as Australia, N:Co.310 is still increasing in importance. In Taiwan N:Co.310 has proved of great value to the sugar industry and Plate I showing the monument erected at Huwei to commemorate the introduction of this variety, illustrates the regard in which it is held there.

N:Co.376 deservedly continued to rise rapidly in popularity. Its contribution of 17.03 per cent of the total crop made it the most important variety after N:Co.310. It is likely to continue increasing in popularity and there is therefore some cause for concern in that in one or two areas a high incidence of mosaic has recently been found.

Co.331 is clearly on the decline, and last season fell from second to third place in order of importance. Its virtual disappearance within a few years now seems almost certain.

N:Co.293, although it formed only 5.23 per cent of the total crop, is a very important variety in some of the high altitude regions, to which it is well-adapted, particularly as conditions here do not favour its tendency to flower profusely. It is to be expected that it will continue to increase slowly.

N:Co.339, forming 4.75 per cent of the total crop, has remained virtually stationary for three seasons. It is unlikely to expand further, as its extreme susceptibility to mosaic disease has proved a very serious drawback in an otherwise excellent variety. It is evident that N:Co.292 as well is not destined to achieve a status any higher than that of a minor variety. In fact, this season its percentage of 2.36 indicated a slight decline in popularity.

Two varieties are listed individually for the first time — N:Co.334 at a percentage of 0.42 and N:Co.382 at a percentage of 1.11. The

marked susceptibility of N:Co.334 to drought seems certain to limit its popularity and it is most unlikely ever to attain the rank of a major variety. N:Co.382, on the other hand, is probably destined to become an important South African variety in the near future. Its expansion will be in part at the expense of Co.331, for which it appears a valuable substitute.

The variety Salvo (N52/211) has not been in commercial cultivation long enough for it to have made any appreciable contribution to last season's crop. Generally this variety appears to have made a favourable impression, but some concern has been expressed at the low sucrose returns which have sometimes been obtained. Salvo seems to resemble Co.331 in this respect and to show a satisfactory sucrose content after growth has been retarded, but a very low sucrose content if harvested when rapid growth is in progress.

PRE-RELEASE TRIALS.

A small number of pre-release trials with the varieties Saccharine (N.10) and Salute (N.52/219) have been harvested. Both of these varieties have consistently shown a higher sucrose content than N:Co.376, but, as is to be expected from single plots, tonnages have been somewhat erratic. These varieties, as well as Saraband (N51/168) and Sabre (N.51/539), have up to now shown satisfactory disease resistance. The decision will shortly have to be made as to whether any of these varieties are to be released for commercial cultivation.

During the year the variety Samson (N.53/216) was sent out for testing in pre-release trials. This variety is derived from the cross N:Co.293 x Co.453. It has not performed well on coastal sands, but in a number of trials elsewhere it has compared favourably with N:Co.376. From the point of view of yielding ability it is probably the most promising of the varieties at present in pre-release trials, but does not appear to have as much resistance to mosaic disease.

VARIETY TRIAL RESULTS.

One trial with seedlings of the N.50 Series was harvested as second ratoons in the Mistbelt area. Salvo (N.50/211) gave the highest yield. Its yield in terms of tons sucrose per acre expressed as a percentage of that of N:Co.376 was 104.1 per cent. The corresponding figure for N:Co.293

The monument at Huwei for the introduction of N:Co.310 into Taiwan by Huwei Sugar Factory, Taiwan Sugar Corporation. Vice-president H. S. Chow with M. E. Hugo of Réunion, April, 1959.

was 80.1, and for Saccharine (N.10) 60.0. Relative to N:Co.376, Salvo's performance improved in ratoons, whereas that of N:Co.293 declined.

The first ratoons of one trial with seedlings of the N.51 Series on Alluvium was harvested. The yields of the two varieties now in pre-release trials, Saraband (N.51/168) and Sabre (N.51/539), proved disappointing, the former giving only 81.7 per cent and the latter only 77.4 per cent of the yield of N:Co.376.

Five trials with seedlings of the N.52 Series were harvested during the year, one as plant cane, two as first ratoons, and two as second ratoons. The variety Salute (N:52/219) was in these trials able to hold its own with varieties such as N:Co.292, N:Co.293 and N:Co.310, but was distinctly out-yielded by N:Co.376. The seedling N.52/451 which had not been advanced from its primary trial as its performance in the plant cane crop was mediocre, improved in ratoons, out-yielding N:Co.376, and it will therefore now be more extensively tested.

Two trials with the variety Samson (N.53/216) were harvested, one on coastal sands as plant cane, and one on Ecca shales as second ratoons. Yields were, respectively, 76.8 and 69.5 per cent of those of those of N:Co.376. However, this variety has already shown indications of being well-suited to the more fertile areas and the Mistbelt region.

During the year one trial with seedlings of the N.54 Series and one with seedlings of the N.55 Series were harvested as plant cane, but selections from these have still to be made.

None of the six seedlings of the N.56 Series, as well as the variety Co.513, showed any promise in their primary trial, and none have been advanced for further trial. A trial with seedlings of the N.57 Series gave more promising results, and six seedlings were selected for further trial. Three of these out-yielded N:Co.376, and the remaining three approximated N:Co.376. Another trial with seedlings of the same series, but under irrigation, was harvested as first ratoons. None surpassed N:Co.310 in yield. From a trial of 47 seedlings of the N.58 series, also under irrigation, four were advanced. Of these, three approximated N:Co.376 in yield, and one out-yielded this variety. Another trial under irrigation, but with introduced varieties, was harvested as first ratoons. The varieties C.B.38/22, C.B. 36/14 and Co.462 all gave better returns than N:Co.310.

THE EARLIER STAGES OF SELECTION.

During the year, microplots at the delta and irrigated environment stations were harvested, being then weighed and analysed for sucrose content. About one hundred seedlings were selected from micro-lines and planted as micro-plots or single lines at each of the environment stations.

A total of 1,176 single line seedlings of the N.60 Series were harvested, weighed and tested for sucrose content. From single stools, 1,614 seedlings were selected and planted as single lines. Another 2,709 seedlings were selected from single stools and planted as micro-lines on the environment stations.

The parentages of seedlings selected for planting in micro-lines, single lines and micro-plots are given in Appendix I.

SEEDLING RAISING.

During 1961 more than 40,000 seedlings were planted singly and more than 10,000 in bunches. These seedlings came from 135 different crosses. Details of the numbers obtained from the various crosses are given in Appendix I.

Seedlings raised at the beginning of 1962 totalled 50,000 and came from 378 tassels. About 43,000 of these were potted singly and about 6,500 in bunches.

Flowering during the 1961 crossing season was exceptionally profuse and even varieties such as P.O.J.2714 which had never been recorded as flowering in Natal, tasselled quite freely. There has in the past appeared to be some relation between high temperatures during March and April and subsequent profuse flowering. It is therefore of interest to note that mean temperatures during March and April, 1961, were 1.6°F higher than the mean for 34 years. Because the season was such a profuse flowering one, it was possible to make the record number of 275 crosses, involving 496 female tassels. Of these, 253 were sown and the remainder were stored in the deep-freeze.

During the period when detached shoots were subjected to artificially raised temperatures in order to increase pollen fertility, a large number of comparisons were made between shoots kept permanently in the glasshouse and shoots moved outside during the warmer part of the day. Out of 212 shoots kept permanently in the glasshouse, 47 later showed fair to very good dehiscence; out of 211 shoots moved outside during the day, 90 later showed fair to very good dehiscence. The increase in the number of male tassels was apparently the result of a decrease in the over-all mortality. The procedure of moving shoots outside during the day is now being adopted as standard practice.

Stalks of some of the more promising seedlings in the later stages of selection were brought to the Experiment Station and allowed to root in a sand-pit adjacent to the glasshouse. Should these flower, they will be readily available for use in breeding.

Cane Diseases

Plant Pathologist : G. M. THOMSON

EXPERIMENTS harvested this year have provided some thought-provoking results particularly in regard to mosaic and its effect on the major varieties, and also in regard to the natural spread of ratoon stunting disease through the soil or by some other agency.

The sugarcane inspector responsible for nursery inspections was kept busy during the year by an apparent greater awareness amongst growers of the value of the nursery procedure in the production of seed cane. This interest is particularly noticeable in some of the larger companies. This is a very re-assuring sign as the smaller growers will be more inclined to follow suit and indeed there is already much evidence of this.

MOSAIC DISEASE.

1. Mosaic Tolerance Trial.

This experiment was planted in September 1960 to determine the degree of tolerance of six varieties to mosaic disease, viz. N:Co's 292, 293, 334, 339, 376 and 382. Unfortunately a mistake was made in collecting the seed cane of the latter variety and it had to be excluded from participation in the experiment. The design of the trial was such that a single stool represented a plot. There were only two treatments viz. "planted healthy" and "planted diseased".

Observations were made at regular intervals throughout the plant cane crop which was harvested at 14 months.

A very noticeable feature of this experiment was the very high degree of variability of the results particularly in regard to weight and height of cane. So great was this variability in fact that direct conclusions were not possible from the results obtained. However it is reasonable to suppose that in all the varieties a loss can be expected due to mosaic infection. This is particularly true of N:Co.292 and N:Co.376. The least effect on the weight of cane was observed in N:Co.334 and not in N:Co.339 as might have been expected.

The decrease in weight in diseased cane is a function of decreases in stalk length and number. However it is not possible to state whether these reductions are a direct measure of the effect of mosaic disease on the plants, as the design of the experiment introduces the complicated factor of competition between diseased plants and adjacent vigorous healthy plants.

Furthermore many of the "planted healthy" stools had become infected with mosaic by harvest so that in effect these stools could not be employed as healthy controls as was intended. This secondary infection also tended to invalidate results from ratoon crops from this trial.

The results obtained from weighing the complete stools and measuring and counting the stalks in each stool indicate the effect of the disease on these varieties (see Table I). An even better idea of the effect is obtained from Plate I.

Table I

Mosaic Tolerance Trial. The effect of mosaic disease on the yields from 5 varieties.

Variety and Treatment			Mean weight per stool (lbs.)	Mean No. sticks per stool	Mean height per stool (feet)
N:Co.292	Planted	Healthy	64.67	29	5.77
,,	,,	Diseased	20.42	14	4.31
N:Co.293	Planted	Healthy	39.00	17	6.18
,,	,,	Diseased	15.08	10	4.80
N:Co.334	Planted	Healthy	47.50	21	5.87
,,	,,	Diseased	26.92	15	5.19
N:Co.339	Planted	Healthy	54.17	30	5.99
,,	,,	Diseased	28.17	20	5.31
N:Co.376	Planted	Healthy	54.25	26	5.60
,,	,,	Diseased	10.58	9	3.27

PLATE I.

Mosaic Tolerance Trial. The effect of mosaic disease on the growth of four varieties (13 months plant cane). Note : each bundle of stalks is a complete stool of cane.

2. Mosaic Resistance Trials.

The ratoon crop of the N.54/N.56 trial was examined at frequent intervals for five months and the final assessment of the varieties reactions to mosaic can be made.

The results confirmed the high resistance of N:Co.382 and Salvo to mosaic and also indicated a similar reaction in six of the seedlings. At the other end of the scale were the very susceptible varieties which include three seedlings along with N:Co.339 and Co.K.32. Evidence of recovery from the disease in the ratoon cane was found in five seedlings as well as N:Co.310 and R.397.

The ratings awarded to the varieties in the trial are as follows :

Very Resistant	—	N.54/- 501, 533, 538. N.56/- 9, 75, 923. N:Co.382, Salvo (N50/211).
Resistant	—	N.54/- 494, 506*, 548. N.56/- 338*, 919*, 1086, 1093, 1164*, 1196*. R.397*, N:Co.310*.
Fairly resistant	—	N.56/- 19, 581, 933. N:Co.293.
Susceptible	—	N.54/529. N:Co.376.
Very susceptible	—	N.56/- 418, 421, 993. Co.K.32, N:Co.339.

* Evidence of recovery in ratoon.

Plant cane observations in the N.54/N.57 trial have shown a somewhat higher degree of infection compared with other seedlings tested in recent years. Regular inspections were discontinued when the cane was 8 months old and at this stage N:Co.376 showed a 50% infection compared with N:Co.339 (38%) and N:Co. 310 (5%). Of the 17 seedlings four showed more infection than N:Co.376 and four had escaped infection.

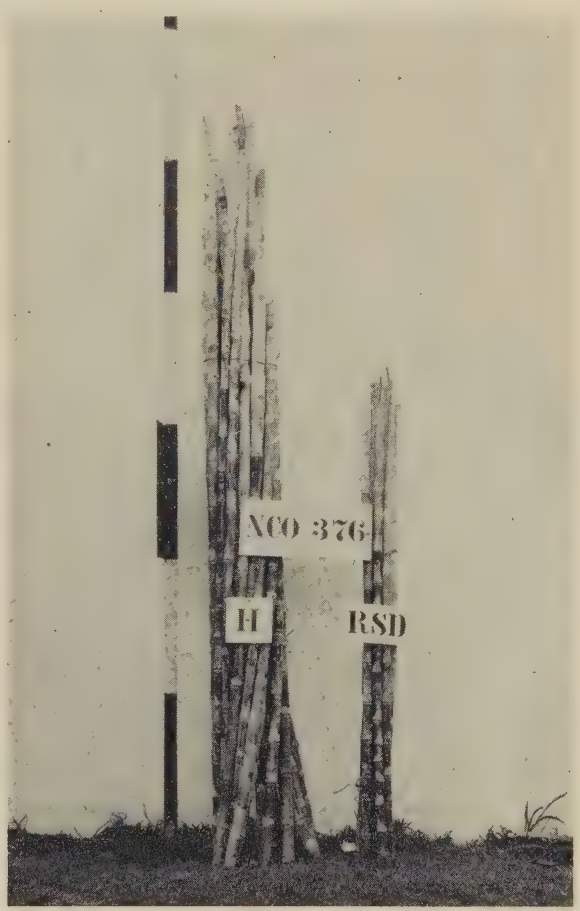
Once again N:Co.382 and Salvo remained free of mosaic but of particular interest was a stool of Salvo found infected with streak disease.

RATOON STUNTING DISEASE.

1. Ratoon Stunting Disease Tolerance Trial.

This experiment was planted at the same time and to a design similar to the mosaic trial described above. The varieties included were Saraband (N.51/168), Sabre (N.51/539), Salute (N.52/219), Samson (N.53/216), N.53/82 and

PLATE 2.



Ratoon Stunting Disease Tolerance Trial. The effect of the disease on the growth of N:Co.376 (13 months plant cane). Note : each bundle of stalks is a complete stool of cane.

N:Co.376. The seed cane was derived from healthy and diseased stock respectively and was not freshly treated for purposes of the experiment.

It is expected that the real effect of the disease will be more noticeable in ratoon cane. However, despite the fact that the variability of results from this trial do not allow definite conclusions to be reached, the indications are that Salute and N:Co.376 were the most adversely affected by the disease (see Table II). The effect of ratoon stunting disease on N:Co.376 is well illustrated in Plate II and seems to be reflected mainly in the number of stalks per stool and to a lesser extent on the length of stalk. An examination of stalks for internal symptoms of the disease revealed these to be particularly well-marked in Samson and N:Co.376.

Table II

Ratoon Stunting Disease Tolerance Trial.
The effect of stunting disease on the yields from 6 varieties

Variety and Treatment		Mean weight per stool (lbs.)	Mean No. sticks per stool	Mean height per stool (feet)
Saraband (N.51/168)	Planted Healthy	46.40	19	5.93
	„ Diseased	44.20	19	5.98
Sabre (N.51/539)	Planted Healthy	40.90	25	5.07
	„ Diseased	32.90	18	5.19
Salute (N.52/219)	Planted Healthy	32.60	14	5.59
	„ Diseased	19.20	9	4.90
N.53/82	Planted Healthy	42.20	17	5.93
„	„ Diseased	41.30	16	5.96
Samson (N.53/216)	Planted Healthy	33.90	16	5.57
	„ Diseased	24.35	14	5.01
N:Co.376	Planted Healthy	39.50	22	5.17
„	„ Diseased	14.75	12	4.13

2. Ratoon Stunting Disease Resistance Trial.

This resistance trial was planted in September 1960 and the single-line plots cut down after 12 months with all necessary precautions to prevent spread of the disease from diseased to healthy plots. The seed cane for the experiment was derived from originally heat-treated stock and for the diseased plots the setts were inoculated with juice from stalks in propagation plots of diseased cane. Included in this trial were the major commercial varieties as well as most of those at present in pre-release trials.

During the growth of the ratoon crop samples were taken and examined for the presence of the internal nodal symptoms of the disease.

On the basis of these nodal spots the difference between healthy and diseased cane was by no means distinct. This difficulty of diagnosis varied considerably with variety. The variety Samson (N.52/216) showed the most distinct symptoms ever seen and for this reason is likely to be valuable in future work on the symptomatology of ratoon stunting disease. Other varieties exhibiting good symptoms were N:Co.293, N:Co.310 and N:Co.376.

It was apparent from the observations made on this experiment that a certain amount of secondary infection had taken place in the plots planted with healthy seed cane. A check on the seed beds showed no signs of the disease. This secondary infection seemed to have occurred mainly in N:Co.376 and N:Co.382 and to a lesser extent in Co.331, N:Co.293, Samson (N.53/216) and Salute (N.52/219). There was hardly any secondary infection in N:Co.310 and none in Salvo (N.50/211), Saraband (N.51/168), Sabre (N.51/539), or N:Co.334.

The agency through which this secondary infection has taken place is unknown at present but the possibility of soil transmission should not be ruled out.

3. Ratoon Stunting Disease Variety Trial.

The fifth crop was harvested from this experiment during the year and once again showed large differences in yield between heat-treated cane and inoculated cane particularly in N:Co.291, N:Co.292, N:Co.310 and N:Co.376. It is interesting to note that Co. 331 and N:Co.293 showed no significant difference between treatments in any of the five crops (see Table III).

In the case of Co.331 this may be partly due to the fact that this variety does not tolerate hot water treatment.

The two varieties most consistently affected by the disease throughout the crop cycle were N:Co.292 and N:Co.376 with highly significant differences between heat treated and inoculated cane in all crops.

An interesting feature of the results from N:Co.376 was the consistently high yields from the untreated plots throughout. These yields were on a par with those of the heat treated plots and suggest resistance to secondary infection in N:Co.376. This apparent resistance was not as evident in the remaining varieties in the trial.

A comparison of the total yields from all five crops shows that diseased N:Co.376 produced 30% less cane than the heat-treated plots as against a figure of 27% for N:Co.292 and 19% for N:Co.310 and Co.281 (see Table IV).

Table III

Ratoon Stunting Disease. Variety Trial
Table of Significance

	H.W. — Nil. Inoc.					H.W. — H.W. Inoc.				
	P	R1	R2	R3	R4	P	R1	R2	R3	R4
Co.281	+	+	+	+	+	+	+	+	+	+
Co.301	—	—	+	+	—	+	—	—	—	—
Co.331	—	+	—	+	—	+	+	+**	+	—
N:Co.291	—	+	+**	+**	+**	+	+	+**	+**	+**
N:Co.292	+**	+**	+**	+**	+**	+*	+*	+**	+**	+*
N:Co.293	+	+	+	—	+	+	+	+	+	+
N:Co.310	+*	+	+*	+*	+*	+	+	+	+	+*
N:Co.334	+*	+*	+**	+**	+	+**	+**	+**	+**	+
N:Co.339	+**	+	+	+*	+	+*	+*	+	+**	+
N:Co.376	+**	+**	+**	+**	+**	+	+**	+*	+**	+*

\+ = Decrease in diseased treatment over healthy * = Significant decrease
— = Increase „ „ „ „ „ ** = Highly significant decrease

Table IV

Ratoon Stunting Disease. Variety Trial.
Total and Mean Yields over Plant Cane and Four Ratoon Crops

	Total Yield (T.C.A.)		Mean Yield (T.C.A.)		Total Nil. Inoc x 100 Total H.W.
	H.W.	Nil. Inoc.	H.W.	Nil. Inoc.	
Co.281	139.83	113.59	27.97	22.72	81
Co.301	230.36	234.50	46.07	46.90	102
Co.331	321.21	322.83	64.24	64.57	101
N:Co.291	303.87	230.91	60.77	46.18	76
N:Co.292	319.62	232.18	63.92	46.44	73
N:Co.293	258.15	249.89	51.63	49.98	97
N:Co.310	297.96	240.36	59.59	48.07	81
N:Co.334	347.75	286.80	69.55	57.36	82
N:Co.339	362.93	310.63	72.59	62.13	86
N:Co.376	406.91	283.68	81.38	56.74	70

RED ROT DISEASE.

1. N.54 and N.56 Series Resistance Trial.

No red rot infection was observed in this experiment even in the Co.290 control plots. In view of this the test varieties should be included in a subsequent trial for re-testing on the assumption that some external factor such as weather conditions allowed a normally suscepible variety such as Co.290 to escape infection.

GUMMING DISEASE.

1. N.54 and N.56 Series Resistance Trial.

The degree of infection in N:Co.310 was satisfactorily high giving a good standard for comparison when assessing the seedlings. The variety Co.K.32 can be classed as very susceptible on a par with N:Co.310. Of the seedlings N.56/581, N.56/1086 and N.56/1164 showed severe symptoms throughout the experiment and can be termed susceptible.

2. N. 54 and N.57 Series Resistance Trial.

The symptom picture in this experiment at the age of six months was very satisfactory with the control variety N:Co.310 well infected throughout. The seedlings have shown a wide range of reactions to the disease from high resistance in N.54/64, N.54/276, N.54/414, B.41227 and C.B.36/14 to high susceptibility in N.57/109, C.P.33/243 and B. 35218.

SUGARCANE INSPECTION.

The disease inspectors carried out four special surveys during the year apart from their routine seedling and nursery inspection work.

A survey of the Pongola Irrigation Settlement in September 1961, covered 58 of the farms. No cases of mosaic were recorded. The most prevalent diseases were gumming in the chronic red stripe phase, and smut. The latter continues to be a problem in this area more so than in any other district. Of the fields inspected 20% were found infected with smut. Although the degree of infection in individual fields was not high, the widespread occurrence of the disease in the settlement calls for long-term planning of control measures. Such measure should include the establishment of nurseries to provide disease-free seed cane, and the changing of variety in cases where fields are replanted because of a high degree of smut infection.

The disease situation in Swaziland was investigated in a two-part survey carried out in October and November 1961. The situation was found to be satisfactory. On one estate N:Co.382 showed its slight susceptibility to smut but the company concerned has its own disease inspection staff and the situation was being kept well under control. Some mosaic was found in N:Co.339 but this variety is not likely to be planted to any large extent.

During the latter part of the year under review a smut disease survey was conducted in the area between Mtunzini and Stanger and extending inland to Eshowe and the Nkwaleni Valley. The survey showed a higher concentration of smut on the coast than in the inland areas. Of the field of N:Co.293 and N:Co.310 inspected 66% and 70% respectively were found infected with smut. No cases of smut were seen in N:Co.376 or N:Co.382.

A considerable number of seed cane nursery inspections was carried out during the year. There appears to be an increasing interest on the part of the private grower as well as the larger miller-cum-planter companies in this important procedure, and the generally very high standard of the nurseries inspected was most re-assuring.

In those areas in which mosaic disease is endemic the quality of the nurseries has greatly improved and although N:Co.376 is still showing susceptibility to the disease the degree of infection has been kept low by efficient inspection by the growers' staff.

The pre-release trials were inspected at frequent intervals during the year. The varieties Saraband (N.51/168) and Sabre (N.51/219) have shown a slight susceptibility to mosaic at Chaka's Kraal and in the Umzinto district. In the Wartburg trial rust disease appears to have had a depressing effect on the growth of these two varieties.

QUARANTINE GREENHOUSE.

During the year 46 varieties were imported from overseas countries and planted in the quarantine greenhouse. Three of these varieties which had come by way of the Stellenbosch quarantine station developed mosaic symptoms and were destroyed while two others were found to be infected with what was probably mottle stripe disease and subsequently also destroyed. During the same period 17 varieties were removed from close quarantine and planted at the Experiment Station.

Cane Pests

Entomologist : J. DICK.

EELWORM INVESTIGATIONS.

SEVERE symptoms of eelworm injury to sugarcane have been noticed mainly in fields on poor sandy soils. Although soil fumigation in such fields may lead to significant increases in yield, the results of a number of trials have suggested that crop response might be limited by the poverty of the soil. It was thought that fumigation might be more effective in combination with soil improvement, which would allow cane plants in fumigated plots to take better advantage of the period during which they were relatively free of eelworms. Results of an experiment mentioned in previous reports showed that a combination of soil fumigation with applications of Oliver Campbell filter-cake was more effective than either treatment alone.

In a field trial on red Recent Sands near Umhloti, the effects were investigated of soil fumigation at three levels of fertilizer application, with or without the addition of magnesium sul-

Table I

TREATMENTS.

Fo	:	No fertilizer.
F1	:	Superphosphate 525 lb., sulphate of ammonia 475 lb., muriate of potash 167 lb. per acre.
F2	:	Superphosphate 1,050 lb., sulphate of ammonia 950 lb., muriate of potash 334 lb. per acre.
Mg0	:	No Magnesium.
Mg1	:	Magnesium sulphate 300 lb. per acre.
EDB 0	:	Not fumigated.
EDB 1	:	Soil fumigated with EDB 2.25 at 40 gallons per acre.

SUMMARY OF RESULTS.

Tons Cane per Acre

	EDB 0	EDB 1	Mg 0	Mg 1	Mean
Fo	29.01	41.22	34.93	35.30	35.11
F1	32.26	48.21	38.02	42.45	40.24
F2	39.19	47.19	42.87	43.50	43.19
Mg0	34.29	42.93	38.61	40.42	39.51
Mg1	32.68	48.15			
Mean	33.49	45.54			

Tons Sucrose per Acre

	EDB 0	EDB 1	Mg 0	Mg 1	Mean
Fo	4.33	5.87	5.13	5.08	5.10
F1	4.65	7.07	5.42	6.29	5.86
F2	5.72	6.69	6.19	6.22	6.20
Mg0	4.98	6.18	5.58	5.86	5.72
Mg1	4.82	6.90			
Mean	4.90	6.54			

phate. Examination of root samples before harvest showed significantly fewer worms in fumigated plots; fertilizer did not affect the number of worms present. When this trial was harvested as year-old plant cane, in October 1961, yield figures as indicated in Table I showed highly significant responses to fumigation and to fertilizer but no significant inter-action. Although magnesium had been added because the level found on soil analysis was thought to be low, this material caused no significant increase in yield.

In another trial in the same area, soil fumigation was investigated together with applications of compost, molasses and coal dust. Twelve months after treatment, there were significantly fewer worms in root samples from fumigated plots. Although the numbers of worms in molasses and compost plots were lower than those in controls the differences here were not statistically significant. Yield figures when this trial was harvested as year-old plant cane which are given in Table II, showed that fumigation had produced a highly significant increase in yield, but that none of the other treatments had been effective.

Table II

TREATMENTS.

Main Plots : Control

Compost, 10 tons per acre applied over the setts.

Molasses, 1,000 gallons per acre, applied 2 months before planting.

Coal Dust, 1 ton per acre, applied 2 months before planting.

Sub - plots : O, no soil fumigation.

EDB, soil fumigation with EDB 2.25 at 40 gallons per acre.

SUMMARY OF RESULTS.

Tons Cane per Acre

	Control	Compost	Molasses	Coal Dust	Mean
0	34.68	35.15	35.31	33.33	34.62
EDB	49.03	43.97	46.59	49.39	47.24
Mean	41.85	39.56	40.95	41.36	40.93

Tons Sucrose per Acre

	Control	Compost	Molasses	Coal Dust	Mean
0	4.95	5.14	4.97	4.87	4.98
EDB	6.95	6.38	6.46	7.15	6.74
Mean	5.95	5.76	5.72	6.01	5.86

When investigated in glasshouse tests, calcium cyanamide had caused a highly significant reduction in eelworm incidence. A field trial in which this material was included at levels of 500, 1,000 and 2,000 pounds per acre was harvested in October 1961 but showed no significant response to treatment, either with respect to cane yield or to numbers of worms found in root samples.

In December 1961, two trials were planted on alluvial soil at Illovo, in an area in which overhead irrigation is practised, the intention being to discover whether the response to soil fumigation might be greater under these better growing conditions. Parasitic worms had been found in appreciable numbers in the soil of both sites, one of which was sandier than the other. Treatments, which were the same in both trials, consisted of three levels of filtercake, otbained from the Illovo Factory, with or without soil fumigation with EDB. Three months after planting, root and soil samples from all plots in these trials were examined with the results shown in Table III. It was found that fumigation with EDB, although

Table III

TREATMENTS

FC 0 : no filtercake.

FC 20 : filtercake at 20 tons per acre.

FC 40 : filtercake at 40 tons per acre.

EDB 0 : not fumigated.

EDB 1 : fumigated with EDB 2.25 at 40 gallons per acre.

RESULTS

Numbers of parasitic worms per sample, 3 months after planting

	Exp. III				Exp. IV		
	EDB0	EDB1	Mean		EDB0	EDB1	Mean
FC 0	61	55	58	FC 0	55	47	51
FC 20	42	31	37	FC 20	35	15	25
FC 40	31	31	31	FC 40	25	16	20
Mean	45	39	42	Mean	38	26	32

it had led to some reduction in eelworm incidence, had not been as effective as in previous trials. An interesting result, however, was the significant decrease in eelworm populations in plots treated with filtercake.

EELWORMS AND SUGARCANE VARIETIES.

Results of a field experiment mentioned in previous reports suggested that varietal differences in tolerance to eelworm infestation might exist. The 1960-61 series of pre-release varieties has now been included in a trial planted at Doornkop, in a field in which previous sampling had indicated an appreciable population of parasitic worms. Each variety was planted in fumigated and untreated plots. Three months after planting, all varieties showed some growth response to fumigation, although examination of root samples at this stage revealed the presence of fairly large numbers of worms in treated as well as in untreated plots.

EELWORM POPULATION STUDY.

In September 1960, observation plots of cane were planted in an infested field near Umhloti, and root samples collected at monthly intervals since that date have been examined for eelworms. During the first season, populations increased fairly regularly to a peak between February and March and decreased, also fairly regularly, until the first spring rain in September. During the second season, populations fluctuated far more erratically, the highest number being recorded at the end of April. It is suggested that population fluctuations are influenced by weather, particularly by rainfall during the preceding month.

This investigation also indicated that different species of eelworms may become dominant at different stages of the life of a crop. During the first season, the predominant parasite was a root-knot nematode belonging to the genus *Meloidogyne*. In the second season, on the other hand, a lesion nematode of the genus *Pratylenchus* became more numerous. Similar observations were made on a field near Empangeni where, in young plant cane, *Meloidogyne javanica* and *M. incognita acreta* occurred in large numbers. Examination of young ratoon cane about two years later indicated that a species of *Pratylenchus* had almost completely replaced *Meloidogyne*.

OTHER SPECIES OF EELWORMS.

Investigations so far have concentrated on species which occur as internal parasites of the roots. Recent examination of soil samples from cane fields has indicated the presence, often in appreciable numbers, of various partial parasites, including species of *Hoplolaimus*, *Rotylenchus* and *Helicotylenchus*, and external feeders such as *Xiphinema*. Since these are all potentially harmful, it is proposed that further investigation on their occurrence and effect on sugarcane should be undertaken.

Review of Weather Conditions

1st JUNE, 1961 to 31st MAY, 1962

RAINFALL.

The average rainfall for 54 recording stations along the sugar belt was 34.10 inches for the year ending 31st May, 1962. Not only was this below the mean annual rainfall of 38.37 inches but it was badly distributed with the important cane growing months of December and February very deficient in rainfall and a severe drought facing the Industry at the end of May.

The first six months of the year here under review were quite satisfactory and in fact the rainfall was above average and totalled 16.56 inches compared with our 38 years' mean of 14.34 inches. Adverse conditions, however, started in December with a rainfall of 2.72 inches or 2.05 inches below average. February had a rainfall of only 2.70 inches compared to our mean for the month of 4.76 inches. April and May were very dry and the total rainfall for the important last six months December to May totalled only 17.54 inches compared with mean value of 24.03 inches.

The drought position was considerably aggravated by the exceptionally high rate of evaporation experienced during the year and particularly for the latter half of the year. Only June and July had rates of evaporation below the mean and June was the only month when the average rainfall in the sugar belt exceeded the evaporation from an open water surface at the Experiment Station. The total evaporation for the year was 52.36 inches at the Experiment Station compared with the 26 years' mean of 46.69 inches.

The average monthly rainfall from the 54 recording stations and the monthly evaporation from an open water surface at the Experiment Station were as follows :

	Mean rainfall in inches 1924-1961	Actual rainfall in inches June 1961-May 1962	Mean evaporation in inches 1936-1961	Actual evaporation in inches June 1961-May 1962
June	1.49	3.76	2.34	2.15
July	1.06	1.08	2.52	2.51
August	1.37	0.80	2.93	3.60
September	2.60	3.18	3.62	4.14
October	3.52	3.60	4.19	4.97
November	4.30	4.14	4.75	5.13
December	4.77	2.72	5.32	6.07
January	4.30	4.08	5.62	5.80
February	4.76	2.70	4.76	5.07
March	5.25	5.20	4.48	5.28
April	2.91	1.99	3.36	4.30
May	2.04	0.85	2.80	3.34
Annual	38.37	34.10	46.69	52.36

TEMPERATURES AND SUNSHINE.

The mean screen temperature at the Experiment Station was 68.5°F for the year or 0.2° below the 34 years' mean. June, July and September were warm months but October was cold. Relatively low temperatures were also experienced during December, January and May.

As is often the case with a dry year, the hours of sunshine were high and particularly so during the latter part of the year. The hours of sunshine for the year were 103.9 per cent of the 34 years' mean.

SUMMARY AND CONCLUSIONS.

Although the first half of the year was on the whole favourable for cane growth with the rainfall actually above average, the last six months were dry and excessive evaporation further desiccated the soil. By the end of May the Industry was suffering from a bad drought which must considerably lower cane yields.

Appendix 1

Exchange of Varieties and the Early Stages of Seedling Raising and Selection.

VARIETIES INTRODUCED.

During the 1961/62 year, the following varieties were introduced into Natal from other countries :

Australia — Cadmus, E.P.C.39/375, E.P.C.39/393, H.32/6774, H.35/198, H.39/5803, I.216, Luna, 30 M.Q.2313, 33 M.Q.371, 33 M.Q.537, 36 M.Q.2717, 54N.6441, 54N.7103, 51N.G.140, 57N.G.155, 57N.G.191, 57N.G.208, P.B.52/1/1, P.B.52/1/7, P.O.J. 3046, P.O.J.3100, Q.66, Q.69, Q.72, Q.73, 47R.2777, Triton, Vidar.

Brazil — C.B.45/3, C.B.47/15, C.B.48/90, C.B.55/72, C.B.55/96, C.B.56/86, C.B.56/171.

Kenya — Co.680, Co.684.

Mauritius — Ebéne 50/47, M.253/48.

Mexico — Mex.52-17, Mex.52-29, Mex.52-56, Mex.53-142, Mex.54-81, J.Mex.55-1601.

VARIETIES EXPORTED.

The following varieties were sent in exchange to other countries :

British West Indies — N.50/211, N:Co.310, N:Co.376, N:Co.382.

French Congo — N.50/211, N:Co.292.

Netherlands — P.O.J.2961.

Pakistan — Albar, Co.S.109, C.P.29/291, C.P.33/243, C.P. 38/34, C.P.47/193, C.P.51/27, 5.E, 6.E, E.16, Q.36, Q.47, Q.50, Q.58, R.366, R.397.

S. Rhodesia — C.B.36/14, C.B.38/22, Co.462, N.50/211, N:Co.79, N:Co.292, N:Co.382.

SEEDLINGS RAISED IN 1961 FROM SEED PRODUCED IN 1959.

Parentage	No. of female tassels	No. of Seedlings	
		Germinated (Estimated)	Planted in field
Co.285 open cross	3	115	113
Co.301 x Co.285	4	720	677
Co.301 x Co.312	8	475	452
Co.301 x Co.331	8	1,150	1,118
Co.301 x Co.421	5	215	200
Co.301 x Co.432	1	5	5
Co.301 x 5.E	2	0	0
Co.301 x N.55/176	2	1,150	608
Co.301 x N:Co.293	3	0	0
Co.301 x N:Co.376	3	13	11
Co.301 x N:Co.382	7	130	126
Co.301 open cross	2	550	520
Co.312 open cross	1	750	102*
Co.331 x Co.205	1	13	11
Co.331 x Co.285	5	9	8
Co.331 x Co.301	6	75	71
Co.331 x Co.432	3	115	105
Co.331 x C.P.27/108	2	240	120
Co.331 x 5.E	2	5	5
Co.331 x N:Co.382	4	36	33
Co.331 x N.F.35	3	180	174
Co.331 open cross	2	110	95
Co.432 x N:Co.292	1	9	9
Co.432 open cross	1	0	0
Co.455 open cross	1	0	0
C.P.34/120 x Co.301	1	0	0
C.P.34/120 x Co.331	1	0	0
C.P.34/120 x N:Co.382	1	3	0
C.P.36/85 x N:Co.292	1	37	35
C.P.36/85 x N:Co.382	1	600	446*
6.E x Co.301	1	1,400	198*
6.E x Co.292	1	0	0
6.E x N:Co.382	1	120	112
G.255 open cross	1	1,850	99*
G.256 open cross	1	21	20
H.M.619 x N:Co.292	1	5	5
H.M.619 x N:Co.382	1	2	1
N.10 x Co.331	1	7	7
N.55/176 x Co.301	1	250	94
N.56/1391 x Co.331	1	0	0
N:Co.79 x N:Co.382	1	450	431
N:Co.292 x Co.205	2	1,250	545*
N:Co.292 x Co.285	4	2,200	2,043
N:Co.292 x Co.301	4	3,850	3,508
N:Co.292 x Co.312	2	750	246*
N:Co.292 x N:Co.293	1	40	37
N:Co.292 x N:Co.376	2	975	443*
N:Co.292 x N:Co.382	5	3,200	1,084*
N:Co.293 x Co.285	5	730	709
N:Co.293 x Co.301	6	3,250	3,166
N:Co.293 x C.P.27/108	4	500	479
N:Co.293 x N:55/176	1	140	130
N:Co.293 x N:Co.376	2	950	534
N:Co.293 x N.F.35	3	160	158
N:Co.293 open cross	2	340	331
N:Co.310 x Co.301	2	190	175
N:Co.310 x Co.432	2	0	0
N:Co.310 x N:Co.293	2	4	4
N:Co.310 x N:Co.382	2	41	36
N:Co.310 x N:Co.390	2	0	0
N:Co.310 open cross	1	30	30
N:Co.339 x Co.285	3	1,700	1,535
N:Co.339 x Co.301	5	1,450	1,373
N:Co.339 x Co.312	1	5	2
N:Co.339 x N:Co.376	2	240	220
N:Co.339 x N:Co.382	1	165	156
N:Co.376 x Co.205	1	190	184
N:Co.376 x Co.285	1	600	522
N:Co.376 x Co.301	5	3,200	3,000
N:Co.376 x Co.312	2	750	181*
N:Co.376 x Co.432	2	0	0
N:Co.376 x C.P.27/108	2	950	906
N:Co.376 x N.55/176	4	1,280	1,234
N:Co.376 x N:Co.292	2	10	10
N:Co.376 x N:Co.293	3	22	22
N:Co.376 x N:Co.382	2	800	69*
N:Co.376 open cross	3	700	668
N:Co.382 x Co.285	2	280	271
N:Co.382 x Co.301	1	45	44
P.O.J.2803 x N:Co.292	1	70	61
P.O.J.2803 x N:Co.382	1	680	100
81 crosses	194	42,547	30,227

* Some seedlings were also planted in bunches.
Altogether about 8,000 seedlings were planted in 709 bunches.

SEEDLINGS RAISED IN 1961 FROM SEED PRODUCED IN 1960.

Parentage	No. of female tassels	No. of Seedlings	
		Germinated (Estimated)	Planted in field
Co.205 x Co.331	1	21	20
Co.205 x N:Co.293	2	7	6
Co.213 x Co.205	1	0	0
Co.281 x Co.285	2	1,500	1,452
Co.281 open cross	2	1,400	1,315
Co.285 open cross	1	13	12
Co.301 x N:Co.382	3	400	378
Co.301 x 51.N.G.91.A	2	0	0
Co.331 x Co.285	3	100	93
Co.331 x Co.312	4	50	44
Co.331 x Co.617	2	70	66
Co.331 x N.53/106	2	275	262
Co.331 x N.53/249	2	0	0
Co.331 x N:Co.293	4	5	5
Co.331 x N:Co.382	3	900	792
Co.331 open cross	4	1,350	1,293
Co.411 x Co.301	1	3	3
Co.421 x Co.281	1	3	3
Co.421 x Co.285	1	525	507
Co.421 x Co.301	1	44	38
Co.421 x Co.312	5	1,550	1,484
Co.421 x Co.331	2	120	104
Co.421 x N.50/93	1	0	0
Co.617 x N:Co.382	1	7	7
Co.L.9 x N.53/106	1	8	8
Co.L.9 x N:Co.376	1	0	0
C.P.44/101 x Co.301	2	0	0
N.50/211 x Co.301	1	3	2
N.50/211 x Co.312	1	3	1
N.50/211 x Co.331	1	0	0
N.50/211 x Co.617	1	1	1
N.50/211 x N:Co.293	2	0	0
N.51/101 x Co.301	1	17	17
N.51/101 x Co.312	1	8	7
N.53/18 x Co.301	1	2	2
N.53/222 x Co.301	1	260	252
N.53/222 x Co.331	1	0	0
N:Co.310 x Co.285	1	36	32
N:Co.310 x Co.301	4	850	793
N:Co.310 x Co.331	5	250	222
N:Co.310 x Co.617	2	12	11
N:Co.310 x N.53/222	2	0	0
N:Co.310 open cross	3	51	50
N:Co.339 x Co.331	3	44	41
N:Co.339 x Co.617	2	920	872
N:Co.339 x C.P.44/155	3	3,300	945*
N:Co.339 x N.50/93	2	18	18
N:Co.376 x Co.281	2	5	5
N:Co.376 x Co.331	3	110	98
N:Co.376 x C.P.44/155	1	45	39
N:Co.376 x N.50/93	1	0	0
N:Co.376 x N.57/1838	1	4	3
N:Co.376 x 51.N.G.91.A	2	14	6
U.S.48/34 open cross	1	300	265
54 crosses	104	14,604	11,574

* About 2,300 seedlings were also planted in 215 bunches.

N SERIES SINGLE LINES PLANTED IN MARCH, 1962.

Parentage	No. Planted
Co.301 x Co.331	182
Co.301 x Co.421	7
Co.301 x N:Co.293	1
Co.312 x Co.301	15
Co.312 x Co.421	6
Co.331 x Co.205	6
Co.331 x Co.301	22
Co.331 x Co.421	77
Co.331 x N:Co.293	42
Co.331 x N:Co.376	5
Co.331 x N:Co.390	1
Co.421 x Co.331	205
C.P.44/155 x Co.312	6
H.M.619 x Co.285	1

Parentage	No. Planted
H.M.619 x Co.301	1
N.53/181 x N:Co.293	1
N.55/176 open cross	9
N.56/1341 x Co.285	25
N.56/1341 x N:Co.293	23
N.56/1341 x N:Co.376	2
N.56/1358 x N:Co.293	4
N.56/1379 x Co.331	38
N.56/1383 x N:Co.293	14
N.56/1391 x Co.331	2
N.56/1392 x N:Co.376	1
N.56/1395 x Co.331	46
N.56/1410 x Co.301	1
N.56/1410 x Co.331	3
N.56/1410 x N:Co.293	1
N.56/1414 x Co.331	24
N.56/1415 x Co.301	4
N.56/1415 x Co.331	3
N.56/1415 x N:Co.376	2
N.56/1419 x Co.331	28
N.56/1424 x Co.285	9
N.56/1424 x N:Co.293	1
N.56/1431 x N:Co.376	7
N.56/1448 x N:Co.293	18
N.56/1454 x N:Co.293	1
N.56/1459 x N:Co.293	3
N.56/1459 x N:Co.376	1
N.56/1460 x N:Co.293	2
N.56/1483 x Co.331	4
N.56/1490 x Co.331	4
N.56/1492 x Co.331	12
N.56/1500 x Co.331	1
N.56/1511 x Co.331	4
N.Co.292 x Co.301	72
N:Co.292 x Co.331	106
N:Co.293 x Co.205	80
N:Co.293 x Co.285	43
N:Co.334 open cross	5
N:Co.339 x Co.301	120
N:Co.376 x Co.301	150
N:Co.376 x Co.331	143
N:Co.376 x N:Co.293	20
TOTAL :	1,614

SEEDLINGS PLANTED AS MICRO-LINES (on environment stations) IN 1961.

Parentage	No. Planted
Co.205 x N:Co.293	113
Co.331 x Co.285	48
Co.421 x Co.312	226
Co.421 x Co.331	212
N:Co.292 x N:Co.382	21
N:Co.293 x Co.301	74
N:Co.293 x Co.331	670
N:Co.293 x N:Co.382	25
N:Co.310 x Co.285	54
N:Co.310 x Co.301	92
N:Co.310 x Co.331	465
N:Co.339 x Co.331	252
N:Co.376 x Co.205	18
N:Co.376 x Co.295	12
N:Co.376 x Co.331	379
N:Co.382 x Co.331	36
POJ.2803 x Co.331	12
TOTAL 17 crosses	2,709

MICRO-PLOTS PLANTED IN SEPTEMBER AND OCTOBER, 1961.

Parentage	No. Planted
Co.421 x Co.301	20
Co.421 x Co.312	60
Co.421 x Co.331	8
Co.421 x G.255	6
C.P.27/108 x Co.331	8
C.P.44/101 x Co.331	2
N:Co.293 x Co.301	3
N:Co.293 x Co.331	20
N:Co.349 x Co.285	76
N:Co.349 x N:Co.293	7
N:Co.376 open cross	1
TOTAL :	211

MICRO-PLOTS PLANTED IN MARCH, 1962.

Parentage	No. Planted
Co.205 x N:Co.293	12
Co.421 x Co.312	38
Co.421 x Co.331	22
Co.421 x Hind's Special	6
C.P.27/108 x N:Co.382	7
C.P.36/85 x N:Co.382	16
N:Co.291 x Co.331	14
N:Co.292 x Co.331	46
N:Co.293 x Co.301	16
N:Co.376 x Co.301	12
N.M.222 x Co.331	11
TOTAL :	200

Appendix 2

SAMPLES RECEIVED AND ANALYSED FOR ADVISORY PURPOSES.

Advisory Samples	1955-56	1956-57	1957-58	1958-59	1959-60	1960-61	1961-62
Soils	5,563	5,138	3,843	8,365	6,763	5,786	3,871
Leaves	2,420	3,133	1,241	1,555	1,719	1,153	709
Fertilizers and Miscellaneous	121	336	517	259	335	260	214
Total :	8,104	8,607	5,601	10,179	8,817	7,199	4,794
Experimental Samples.							
Soils from Regional Fertilizer Trials	0	895	1,020	810	565	643	522
Leaves from Regional Fertilizer Trials	0	1,767	5,246	4,343	5,547	675	792
General Experimental Soils	89	630	1,218	1,574	1,462	2,222	2,862
General Experimental Leaves	178	2,194	2,402	676	1,227	447	1,126
Total :	267	5,486	9,886	7,403	8,801	3,987	5,302
Yearly Totals :	8,371	14,093	15,487	17,582	17,618	11,186	10,096

Appendix 3

PUBLICATIONS OF THE EXPERIMENT STATION 1961-62

BULLETINS

No.14. Some notes on the use of herbicides in ratoon fields.

CIRCULARS

Notes on Coffee production.
Cotton production in the cane belt.

PAPERS, REPORTS, ETC.

Anderson, J. R. Urease activity, ammonia volatilisation and related microbiological aspects in some South African Soils. Proc. S.A.S.T.A. 1962.

Anderson, J. R. Free-living nitrogen-fixing bacteria in Natal sugarcane soils. Proc. S.A.S.T.A. 1962.

Anderson, J. R. Notes on a minor stalk ailment of sugarcane in Natal. Proc. S.A.S.T.A. 1962.

Beater, B. E. and Maud, R. R. Soil series in the Natal sugar belt. Proc. S.A.S.T.A. 1962.

Maud, R. R. Soil moisture relationships in some Natal sugar belt soils. Proc S.A.S.T.A. 1962.

Wood, G. H. Some factors influencing starch in sugarcane. Proc. S.A.S.T.A. 1962.

GENERAL PUBLICATIONS IN S.A. SUGAR JOURNAL

Coffee — some historical notes	Vol. 45, No. 6
Flowering of Cane	Vol. 45, No. 8
Crop production in the cane belt	Vol. 45, No. 9
Developments in chemical weed control	Vol. 46, No. 4
Zinc deficiency	Vol. 46, No. 5
The disease position	Vol. 46, No. 6

EXPERIMENT STATION BULLETINS

No. 1.	1956.	Gumming disease in Natal.
No. 2.	1957.	Fertilizer responses.
No. 3.	1957.	Comparative yielding ability and disease resistance of South African cane varieties.
No. 4.	1957.	The identification of the more important sugarcane varieties grown in South Africa.
No. 5.	1957.	The growth and development of the sugarcane plant.
No. 6.	1958.	Sucrose formation and concentration in sugarcane.
No. 7.	1958.	The production of new sugarcane varieties for Natal.
No. 8.	1958.	Sugarcane pests in South Africa.
No. 9.	1958.	Diseases of sugarcane in Natal.
No. 10.	1959.	The development of sugarcane breeding in South Africa.
No. 11.	1960.	Liming in the sugar industry.
No. 12.	1960.	Trashing.
No. 13.	1960.	A guide to the use of fertilizers.
No. 14.	1961.	Some notes on the use of herbicides in ratoon fields.

H. & H. LTD. — 94563